CHEMICAL & METALLURGICAL ENGINEERING

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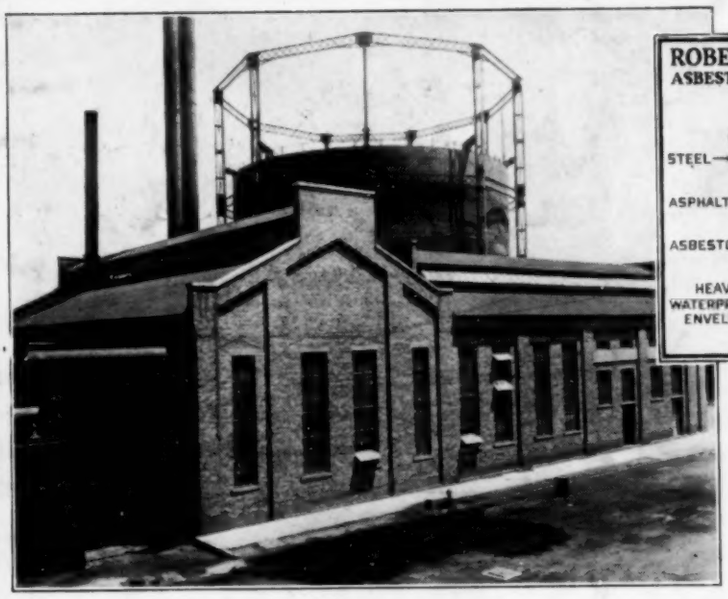

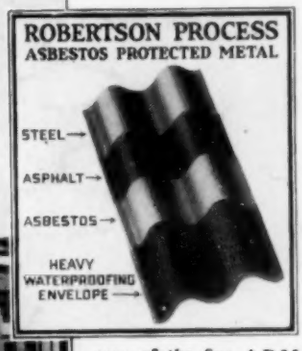

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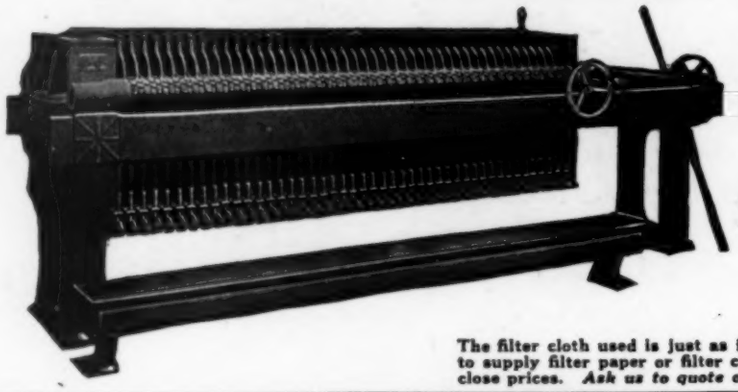

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CHEMICAL & METALLURGICAL ENGINEERING

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Beginning At Home

NO MATTER how good a thing is it can be improved! And in the opinion of our resourceful friend G. L. W., whose editorial on "The Roots of the Society" appears in the November number of *The Chemical Bulletin*, that improvement should begin at home. His reference is to the local sections of the American Chemical Society. To many of us the national policies and conduct of that organization have long been regarded as fitting subjects for comment and criticism, but very often we are inclined to forget the fertile field that lies at our very door. For it is the local section of the society that offers the real opportunity for constructive service. It should be built up and strengthened until its influence is recognized in the community. If it is not and if the section is loosely organized, lifeless and ineffective, then the fault is with us and it is from within rather than from without that improvement must come.

In traveling about the country we have often remarked the difference in character and activity of the local groups of chemists. At Pittsburgh, for example, we were most favorably impressed by the evidence of their closely knit organization, which apparently receives the whole-hearted support of the many chemists in that busy district. On making inquiry, we found that this enthusiasm is almost directly traceable to the interesting social activities of the section—to the monthly smokers and to the annual field day and picnic.

But it was at Indianapolis that we discovered the chemists as a group playing a leading rôle in local affairs. For years it has been the custom of that section to hold weekly luncheons—and contrary to general experience with most weekly luncheons, these are unusually well attended. Formerly these meetings were concerned almost entirely with subjects of interest only to chemists, but of late problems of a broader and more general significance have been considered. As a result the laymen and the newspapers of Indianapolis have come to look to the section for an expression of opinion, not alone on matters chemical but on many local issues of professional and public interest.

Thus zealous promoters of schemes for obtaining "wealth from the air" or for solving the nation's motor-fuel problem with Indiana lignite have sometimes suddenly found themselves confronted by a little investigating committee of Indianapolis chemists. Somehow or other these men have a reputation for getting at the bottom of things very quickly and usually it is the people of the community who are benefited. Likewise not long ago an enterprising department store was convinced of the wisdom of abandoning some misleading advertising of "radio-active golf balls"—even though sales were mounting among enthusiasts who had been led to believe that radio-activity had something to do with longer drives and lower scores.

These are but a few of the ways in which this section of the society is making itself felt in the affairs of Indianapolis. Doubtless similar examples could be found in other parts of the country, but certainly these are sufficient to show that the local section of the American Chemical Society is one of the most logical agencies through which the chemist can be of effective service to his community, to his profession and to himself.

The Science and Art Of Baking

THE art of baking is making its way into chemistry, or perhaps *vice versa*. For years Dr. KOHMAN has been working at Mellon Institute, and in 1919 the American Bakers' Association organized, with the help of the National Research Council, its Research Institute, first at Minneapolis and later at Chicago. In the October number of *The Chemical Bulletin* A. W. LANDSTROM contributes a descriptive article of the Institute's new establishment. The work is divided into two parts: the scientific and technical, and the educational. In the laboratories research is carried on and tests are made for members. Advanced research is also conducted in co-operation with several universities. The laboratories have published findings on control of rope, studies of molds, strength of flour as affected by enzymes in the flour and those added in malt extracts, relation of strength of flour and the viscosity of dough made from it, and a lot of other subjects.

At the same time a school of baking is conducted in which foremen are trained and the incidence of scientific control is made clear to them. In the research laboratory a number of advanced students have already completed work which has led to the degree of Ph.D.

When we consider baking in its chemical and biological aspects, the requirements of temperature and humidity as well as the control of materials having such difficult qualities to master as flour, and the manifest complexities of the phenomena that accompany shortening processes, it soon becomes evident that instead of dealing with a craft to be learned by rule of thumb we are facing a great chemical industry.

Our readers may recall an incident we mentioned last winter when a young graduate chemist asked us if we could help him obtain a position in a chemical works in his home town. The company in question was not seeking additional chemists at the time. So we pointed out a large bakery and suggested that he could surely find plenty to do there. "But they don't want a chemist," he said. "That," we replied, "is what gives you your chance. If they knew they needed one, they would get a man of experience; they wouldn't take you. But if you can get a job of any sort there you can find all

sorts of opportunities to apply chemistry and make yourself a man of great value to them. They need a chemist, but don't know it. You can take almost any job in the bakery and teach them what they need to know—if you have tact. And if you have patience along with tact, they will probably pay you well for your services." Before long these chances will not be available. Bakers are beginning to learn that they are engaged in chemical industry.

Metallurgical Education

ONCE upon a time we were guilty of circulating a "questionnaire"—that was in the days when "drives" and "questionnaires" were more often endured than now. We wished, if possible, to assemble detailed information on metallurgical education, as it then existed, to supplement the impressions gathered by visits to a few of the larger technical schools. Furthermore, it might be possible by that means to discover a course in metallurgical engineering which we could enthusiastically recommend to inquiring high school graduates.

Like most questionnaires, the thing was a failure. One of the schools giving the poorest return on paper looks the best upon inspection, while the opposite also turned out to be true. One thing it did, though, was to collect a large number of curricula. And upon examination they were found to be slight adaptations of conventional courses of study in other branches of engineering.

Apparently it works about like this: A certain institution has a school of mines or is teaching mining engineering. Its attendance drops, or the students who attend ask for more and more information about metal and less about ore. So the dean or somebody in authority says, "We shall offer a degree in Metallurgical Engineering," and the next catalog contains the curriculum. It looks like mining engineering, except that Advanced Metallurgy replaces Economic Geology and a 2-hour lecture course on Non-ferrous Alloys is substituted for Hoisting.

You will say we have used "editorial license"—but the point we wish to make is this: That at the present time American colleges are offering courses which are not metallurgical engineering but are grafts or crude adaptations of older courses such as mining or chemical engineering. (If there are any exceptions we should like to hear about them.) Therefore we find such preposterous subjects as mine surveying, fire assaying, and organic chemistry taking up sadly needed lecture hours and laboratory afternoons. Such are, of course, not "preposterous" in their right place, but are they essential to a metallurgist?

Thoughtful educators and men in industry are coming more and more to agree that the fundamentals of the soundest technical education are a thorough groundwork in the great art of language and the sciences of mathematics, chemistry and physics. Furthermore, to be of greatest value to his country and to himself, the student should also attend a series of studies in history, literature, fine arts, psychology and economics—in fact, if one could find a College of Liberal Arts that would put great emphasis on a thorough understanding of science, that would be the best place for an engineer—any engineer—to prepare for his life work.

But all these things take time. Four years is not enough for these studies, plus the metallurgical specialties, plus mine surveying, fire assaying and organic chemistry. So it is that the 5-year course is being talked about and experimented with and in some universities the engineering department has actually become a branch of the post-graduate school.

Admitting that the more education the better, it should still be borne in mind that the large majority of students in American universities will balk at a 5- or 6-year course. Even during the fourth year the urge to get out and be doing something is very strong; graduation day seems interminably long in coming. Of course there are a few who wish to pursue their formal studies further, but the place for the engineer to specialize is after he gets his job. If he is properly grounded in science, he can easily learn how to doctor a sick blast furnace and will humor its whims with understanding. The science he can never pick up in the works—neither can he be taught the "practical details" on a blackboard. It appears that this time limitation will never be overcome—at least in metallurgical engineering—until the axe is taken to the present schedules of studies. We look for great things when some energetic and influential educator goes after one of these hybrids with a big sharp axe, demands that the freshmen be taught how to study, lays out a broad and exacting course in the sciences and humanities, and then puts the onus of co-ordinating these things—showing the student what relationship the law of mass action has to open-hearth practice—squarely up to the engineering faculty. Then we shall have a course in Metallurgical Engineering.

Wage Rates and National Income

IT IS frequently remarked that the clamor for "the living wage" on the part of certain groups of workmen is improperly based, because it calls for an income that could not be spent, the goods represented being more than the whole country produces. It is held that what is really wanted is more goods, and that the way to obtain more goods is to produce more, not to try to pay out more dollars in wages, since by that course the competition of wage earners would merely increase and market prices of goods would rise.

The reasoning is perfectly sound. It is a case of distributing the national income. Occasionally it is suggested that if we cannot produce as much as we want we should import more. There is the 15 billion dollars or more that is owing us from abroad, the interest alone on which would amount to a tidy sum and might be paid in goods, while beyond that we could export goods such as we can make to better advantage than foreigners and with less labor, and receive in return goods that require much labor in their production.

This reasoning also seems sound, for the essence of foreign trade is that of exporting goods that one can make easily and getting in return goods that one has difficulty in making.

In the combination of these two ideas, however, there is a feature that does not seem to have been brought out. That feature is that the three groups of labor that are making the most trouble from an economic standpoint, those that appear to want more than their natural share of this country's production by comparison with other classes of workers, are engaged in activities that cannot be supplemented by importations. No one at all conversant with current conditions can have any difficulty in identifying these three groups. Everyone knows that they are the coal miners, the artisans in the building trades and the railroad work-

ers. They are all being paid too highly by comparison with what the remaining workers in the country receive.

It is altogether impossible for us to import coal in quantity. Our coal is the most easily mined of any and we should export rather than import. We cannot import garages and dwelling houses, which are being built in great numbers this year and at an altogether unreasonable cost. We cannot import transportation.

In the case of manufactured goods we depend upon imports to prevent production costs from going to unreasonable levels. We pretend, in theory at least, to construct our tariffs to cover the proper and legitimate differences in cost of production as between the United States and foreign countries. If the theory were carried out in practice, then any demand for unreasonable wages on the part of workmen or unreasonable profits on the part of manufacturers would induce imports and thus bring to bear a restrictive influence. In coal, transportation and building, this principle cannot apply.

Our new tariff has been rather generally criticised and unpleasant economic consequences from it have been predicted. As a wage raiser the tariff cannot be credited for the highest relative wages that are being paid in the United States, for they are being paid in lines of activity the tariff does not touch. Nor, on the other hand, can the tariff be blamed for the economically unsound condition of wages being unduly high in the three lines of activity to which reference has been made.

Sir William Bragg And His Crystal Units

DESPATCHES purporting to be special and by cable, lately appearing in various newspapers, tell of the discovery of the crystal unit by Sir WILLIAM H. BRAGG and his son, Prof. W. T. BRAGG. Expository information which follows the announcement has been misleading, and, so far as we have observed, characteristic of "newspaper chemistry."

The despatches have their origin in the September meeting of the British Association for the Advancement of Science held at Hull in September. Here Sir WILLIAM delivered an address from which the information was taken. In a previous work by these eminent physicists on the X-Ray Analysis of Crystals they tell of the origin of their investigations, which followed the work of Dr. LAUE of the University of Zurich. Dr. LAUE was ambitious to cause and measure the differentiation of X-rays, on the hypothesis that they partake of the nature of light. By means of a spectrometer with a diffraction grating, the length of so-called light waves is determined. The grating, as is well known, consists in an arrangement of equidistant parallel lines, ruled in great numbers on glass or a metal surface. The spacing must be of the order of the wave lengths measured; thus sodium light with a wave length of 0.0000589 can be diffracted through 24 degrees by a grating of 7,000 lines to the centimeter—that is, a spacing of about 0.000143 centimeter.

Now the X-ray wave, if there is such a thing, is about 10,000 times as short as the waves of sodium light, and to construct an appropriate grating for this purpose is unthinkable. The spacing would be of the order of distances between the molecules of a solid. This very fact appealed to Dr. LAUE, because in crystals we have a solid in which the atoms or molecules must be arranged in some definite order. By experiment he demonstrated that, if a pencil of X-rays is made to traverse a crystal, the diffracted pencils show arrangements about a primary beam in regular patterns, and these patterns differ according to the crystals employed. This gave Mr. LAUE his results. In other words, X-rays were diffracted through crystals, as light rays are produced from diffraction gratings.

Then the BRAGGS, father and son, at that time attached to the University of Leeds, became actively interested in Dr. LAUE'S conclusions and in the photographs which he published, because they concluded that this very diffraction of X-rays would give them the basis for the more intimate study of atoms and molecules in crystals. Magnificent work on their part, by HULL, ST. JOHN, BAIN, KAYE and other workers in England and America, has resulted in the invention of the X-ray spectrometer, its application to mixtures of very fine crystals, and the solution of many baffling problems of allotropy, isomerism and solids of colloidal size. Many readers will recollect the contributions to theoretical metallurgy, published by Dr. BAIN at intervals in these columns. Others, more familiar with the work done on the other side on salt crystals, will remember, for instance, that in the crystals of such halides as sodium chloride, potassium chloride, etc., it was concluded that each atom of one element organizes itself between four associated atoms of the other, so that, instead of aggregations of molecules forming the crystals, we have a symmetrical order of opposed atoms which constitute the crystal as a whole.

Now it is evident that the BRAGGS have gone beyond this, and reached a new conclusion in regard to crystal units. We quote from Sir WILLIAM'S address at the Hull meeting of the British Association in September:

"Every crystal is built up of units, and every unit is the counterpart of the crystal. The crystal unit contains every kind of atom or bond; every feature and every property that the crystal possesses as a whole.

"X-ray analysis tells us the number of atoms in the unit, and is throwing more and more light on their arrangement.

"The limitation to our knowledge of the properties of gases and liquids is severe. We remove it when by aid of X-ray analysis we examine the nature of crystal units, because the unit displays all the properties of the solid.

"A crystal has elasticities, thermal expansions, thermal and electrical conductivities, dielectric capacities, optical activities, and these not only as scalars, but as vectors.

"The many properties, for example, of quartz as a crystal, are all displayed by its crystal unit—i.e., by three molecules of SiO_2 arranged in a particular way. They are not characteristic of the separate molecules of SiO_2, still less of the separate atoms of Si and O.

"When we know the exact arrangement of the nine atoms of this unit, we can apply all that we know about quartz to that small group. In this way a wide field of research opens out in which the crystal unit plays a part like that of the molecule in other fields. And the magnitude of the results may be just as great."

It is difficult to grasp the bigness of this work, or to measure its significance. It is almost like a flash of lightning over an undiscovered country, and we await with eagerness the more detailed publication of studies by this gifted father and son on the order and arrangement, and the nature of the organization of atoms and molecules in solids.

Readers' Views and Comments

Why We Are Publishing the Articles on European Conditions

To the Editor of Chemical & Metallurgical Engineering

SIR:—The publication of my first two articles on "European Conditions as I Saw Them" and my letter on "Who Financed the German Economic War" have raised the question of my purpose in expounding a situation that may be regarded by some as being more in the domain of politics. It is true that there is a political aspect in the subject under discussion, but of far greater importance is the fact that in Germany's present plight we have a condition that has such a concrete repercussion on the economic status of the whole world that it is worthy of the attention of engineers. Far be it from me to tackle the subject from its political side. My aim is to bring home to American technical and industrial men the fact that they, more than all the politicians and bankers together, ought to know the real causes of existing industrial conditions in Germany, in the expectation that by this means engineers could be moved to develop a policy that would bring back all of the European industrial countries to a stage of constructive production.

In a conversation on March 13, 1922, with Prof. Edgard Milhaud of the International Labor Office at Geneva, Switzerland, he pointed out that a very great part of the blame for the distress in Europe is traced directly to America, which, he said, financed the war so efficiently but is now taking refuge under a turtle shell when so much assistance is needed to finance peace. Subsequently I learned things that brought me to the conclusion that Germany was really leading an economic war as outlined in my first article; that politicians were lulling their nationals with notes and counter-notes spread broadcast; that bankers were watching hawk-like for opportunities to do business and that unscrupulous middlemen were beating all the others in making sure of the bird in hand rather than laying plans to get two in the bush. Finally, I think now as I did April 24 when I wrote in my diary as follows:

"America, although now the greatest loser from the above unhealthy condition, because her industry and commerce feel acutely the effect, is bound to come out the winner in the end, not only because she has the raw materials and modern machinery, but mainly because her industrials, merchants and workingmen possess, as a rule, the mentality of square dealing to an extent not existing in the above-mentioned countries [France, Belgium and Germany]. But instead of waiting until this turn arrives *per se*, which in itself might also lead to the equally bad, if not worse, condition of only America working while the others were bankrupt, we must do something to stop such disastrous consequences and try to pave the way to a sane return of normal conditions when everyone will have an opportunity to do his share of honest work. And we must hasten the arrival of such conditions by using the least radical means."

The fact is that now, only a little more than 6 months after the above was written, America more than any other industrial country is working and enjoying relative prosperity. But we are gradually approaching the undesirable condition of becoming a mere receptacle of the world's wealth, with little, if any, international interchange, while the stricken European countries are beginning to pour their wrath on the "tentacular United States" (Les Etats Unis Tentaculaires), a very suggestive heading on an article in the *Echo des Mines et de la Métallurgie*. We in the United States know that we are not as guilty as all that, but we do nothing to dispel the rapidly growing misconception of the European technical press.

No, when I wrote the series of articles now being published in *Chem. & Met.*, I did not intend to tackle politics nor did I aim to play the omniscient accuser. My real aim was to inform the American technical world through the columns of a technical paper what I, as an engineer and one of your staff, saw and learned while traveling through Europe. In so doing I was guided by the sincere expectation that I might open up a hitherto unexpressed line of thought in order that engineers, American engineers included, might initiate a policy that would hasten the arrival by the least radical means of a condition where everybody could have an opportunity to do his share of the world's work. I am confident that the reaction of American as well as foreign engineers and industrials, after they have read the full series of articles, will be in this direction.

New York City. J. S. NEGRU.

What Is Steel?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Only a day or so after reading your editorial on "What Is Steel?" (issue of Nov. 8), I clipped the following from the Brooklyn *Daily Eagle:*

Memory Test
Can You Answer These?

1. Who discovered that the blood circulates through the body?
2. Why does the wind whistle?
3. What is steel?
4. When is Indian summer?
5. Where is the Cape of Good Hope?

"Ha! ha!" said I to myself, when I got to No. 3, "there's where I fool the Memory Test." Nevertheless I bought the *Eagle* the next day (possibly to find out Why does the wind whistle?) and read:

"3. Steel is a compound of iron containing 0.25 to 3 per cent of carbon."

There you are! And it took you nearly a page to say it. MARTIN SEYT.

Titanium Alloys

Of the titanium alloys, only four are in commercial use, ferrocarbon titanium, ferrotitanium, cuprotitanium and manganotitanium. Information regarding these alloys is contained in Serial 2406, "Titanium," which may be obtained by addressing the Bureau of Mines, Washington, D. C.

European Conditions as I Saw Them*

Impressions Gathered During the Extensive Trip Through the Devastated Coal Districts of Northern France—Proof of Wanton Destruction and Active Reconstruction Are Conspicuous, as Illustrated by the Typical Cases at the Anzin and Béthune Coal Mines

By J. S. Negru

ON MY TRIP from Brussels to Paris I passed over many of the battlefields of the late war, and observed that a large number of the small cities and towns were still in ruins. The removal of débris and the reconstruction of homes and factories were only partly done, being necessarily postponed until at least a part of the needed money could be obtained from reparation funds. The fields, on the contrary, were already well leveled, and looked as if they had never been covered with numberless shell craters of varying sizes. Later, I learned that agriculture, more than any of the other devastated French industries, was already practically on a pre-war basis. In the industries other than coal mining, the condition was quite the same, and progress in their reconstruction could be measured only by the amount of money available for actual work.

In the coal industry, however, the conditions are entirely different. Here it is not sufficient merely to have the money for reconstruction work, for not only were surface plants at the mines totally or partly destroyed, but the underground workings were also damaged. Anyone who is familiar with the geology of the coal seams of northern France and the complicated underground workings necessary for mining operations can readily understand why, in addition to large sums of money, a vast amount of arduous work is necessary to repair a damaged French coal mine.

Visit to the French Devastated Region

In May I had an opportunity to visit the devastated coal region, including the mines of Anzin, Lens, Béthune, Liévin, Noeux and Bruay. All of the physical facts and data regarding these mines have been published in elaborate monographs on the French devastated industries, and consequently I shall not indulge in a repetition of this phase of the subject. On the other hand, I should like to mention the relation of the French coal mines to the bitter animosity existing between Germany and France.

I visited the coal region after I had been in Germany and had talked there with intellectuals and common people. Consequently I thought it well, when I was on the ground in France, either to corroborate or refute the German contention that the destruction of the mines was not done wantonly, but that it was an inevitable result of warfare. I wanted, also, to discover how much truth there was in the German statement that the reconstruction of the destroyed French coal mines was voluntarily held back by the French mining companies.

I know now that both of these contentions are wrong. There was wanton destruction of the coal mines, and there is, on the part of the French people, a feverish desire to restore the mines to working condition as fast as funds can be obtained.

It may suffice to cite in corroboration of these statements two typical cases based on official information obtained during my visit.

Destruction of the Anzin Company Mines

The Anzin company was working twenty shafts in 1913, and produced on an average 11,400 tons of coal per day. On Oct. 8, 1918, all of the mines were in good order on the surface as well as under ground. Ventilation and pumping were going on as usual, and the mine horses were still under ground.[13] On this date the general director of the company received an order from the German military authorities to remove the horses from the mines and to stop ventilating and pumping operations. A few days later the technical staff of the Anzin organization was assembled and carried away to Liége, Belgium, and systematic destruction of the mines was begun.[14] All of the tipples, boilers, hoisting machinery, compressors, ventilators, electrical equipment and power houses were completely destroyed. One washery was totally destroyed and another badly damaged. Three of the briquet plants were totally destroyed. The Thiers shaft was badly damaged, 135 miners' houses completely razed, 15 railway switch and signal stations completely destroyed and about 13 miles of track systematically dislocated. Apparently, there was not time to complete the work of destruction, and so the repair shops, some of the screens, washeries, briquetting plants and coke works escaped. A few days before the armistice, the bombarding of this district added to the destruction, so that at the signing of the armistice all of this important coal district was a heap of ruins, with shafts damaged and the mines flooded.

Reconstruction of the Anzin Company Mines

Immediately after the armistice reconstruction work was begun. At the end of June, 1919, six of the twenty shafts were already in such shape that they could be partly worked, yielding a daily output of 1,270 tons, as compared with about 11,400 tons in 1913. The comparative daily production in these six mines for corresponding periods in 1913, and June, 1919, is shown in the following figures:

1913: 679, 873, 412, 453, 808, 1,268
1919: 87, 612, 120, 80, 295, 76

By the end of 1921 the total daily production of Anzin company was about 7,100 tons, as compared with 11,400 in 1913, and at the present time the daily production has approached the 8,000 ton mark. Only two of the twenty mines cannot be worked yet and some of the repaired mines produce now even more than before the war, as can be seen by the following figures of average daily production in tons of coal, in 1913 and in December, 1921:

Mine	1913	Dec., 1921
Lagrange	873	975
Bleuse Borne	415	442
Ed. Agache	539	708

*This is the fifth of a series of articles by Mr. Negru on this subject. The preceding articles appeared in the issues of Oct. 18, Oct. 25, Nov. 8 and Nov. 15.

[13]Haulage in the coal galleries is done by horses. Once they are in the mines, they are kept there as long as they are alive. This is the invariable rule.

[14]Note the date. On Oct. 8, 1918, revolution was already fomenting in Germany.

These figures show clearly that the company has been working feverishly to repair the destroyed mines and to bring the coal production as fast as possible to the pre-war figure.

Destruction of the Béthune Company Mines

The case of the Béthune company furnishes a more striking example of wanton destruction. Shafts 8 and 8bis were occupied by the Germans on Oct. 11, 1914, and were abandoned by them only in the beginning of October, 1918. As these shafts were only a few hundred yards from the first-line trenches, it is small wonder that the surface works were reduced to a heap of ruins. But it was not to be expected that the shafts would be found in such condition as to give unmistakable evidence of wanton destruction. Official evidence indicates that this was done after September, 1917. When it was possible to inspect these shafts, it was found that the metal linings had been badly damaged, especially at the 50- and 100-ft. levels of shaft 8bis. The accompanying drawing of this shaft in elevation shows better than words can describe the condition of its metal lining.

It is now officially known that, in order to accomplish this result, the Germans drilled a series of holes about 10 in. in diameter and about 100 ft. deep at a distance of 3 ft. from the lining of the shaft. These holes were charged with high explosives at the 50- and 100-ft. levels, and similar charges were placed in the shaft at corresponding positions. The firing of these charges quickly accomplished the work of destruction. In addition to this, the shafts themselves had the appearance of craters, due to the explosion of well-placed charges. At one shaft the crater measured about 70 ft. in diameter, and at the other 50 ft., while the ground was well shattered to a depth of about 50 ft.

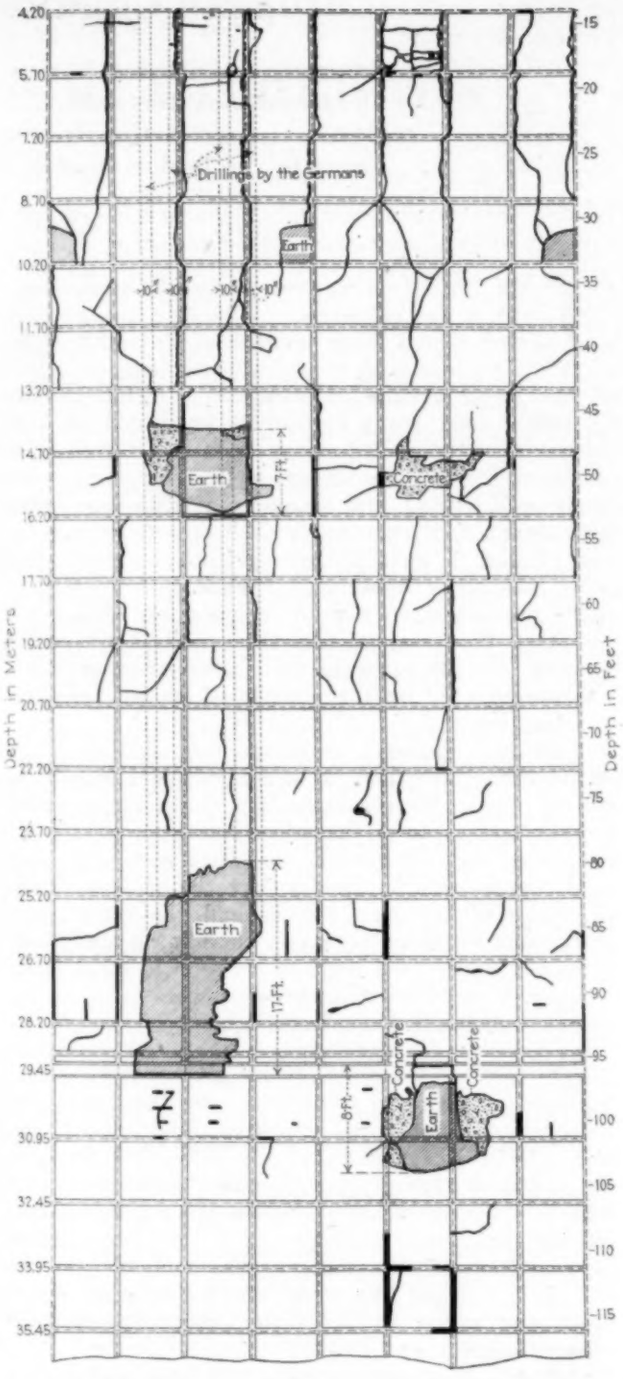
Difficulty of Reconstruction Work

The ground in this district is highly water-bearing, and consequently the repair of the shafts has been a gigantic and difficult task. Nevertheless the company has already succeeded in repairing the shafts up to within a few feet of the bottom of the craters. The repair work still to be done will require several years, although the work of destruction took but a short time. How thoroughly and systematically the latter was done can be judged by the time required for the vast amount of reconstruction work already completed, as well as by the work remaining to be done.

These two examples suffice, I think, to show that wanton destruction on a large scale was perpetrated by order of the German military authorities. At whose instigation this work was done, we can judge only by circumstantial evidence. It appears to have been accomplished in the interest of German industrials. But of the actual facts of destruction, the German people are not generally aware, even at this date.[15]

Need of Acquainting the German People With the Conditions in the Devastated Districts

During this visit to the French coal fields I talked with many leading French engineers, and was led to suggest the merit of having a commission of German engineers visit the devastated coal region. I felt that an honest report by such a commission would aid the German people in getting a fair conception of the wanton destruction of the mines and of the reconstruction work already accomplished, and thus alleviate in some degree the bitter spirit of hatred displayed toward the French. Particularly, I broached the subject to Messrs. Champy, the general director of the Anzin company, and Gruner, vice-president of the Central Committee of French Collieries. They all saw the value and utility of such a plan, and the general response was that such a commission would be welcome. When I returned to Germany after having visited the French coal fields, I discussed the subject with many people, and particularly



ELEVATION SHOWING THE DESTROYED METAL LINING OF SHAFT 8BIS, BETHUNE, FRANCE

[15] At this point permit me to recall a personal incident that occurred a few days after the armistice was signed. I was then in St. Ghislain, about 5 miles from Mons. In visiting a tile plant, which had been transformed into a bath house during the German occupation, I observed the utter destruction of all the machinery. In the repair shop my attention was attracted particularly to an ordinary blacksmith's bellows which was still covered with leather and apparently in good condition. In view of the fact that the Germans were greatly in need of leather during the war, I wondered why they had not taken this. Thereupon Mr. van H., the owner, showed me that it had been sharply cut from top to bottom, thus rendering it useless.

with Prof. Dr. Matschoss, director of the Verein deutscher Ingenieure (Society of German Engineers), and with Prof. Dr. Rassow, general secretary of the Verein deutscher Chemiker (Society of German Chemists), and expressed the belief that if the findings of such a commission were made public through the technical press, it would do the German people a world of good. Here, however, the suggestion met with passive indifference.

Policy of Miners' Dwelling Rentals

In the reconstructed coal mining towns in France, I understand that there will be practically no private dwellings. The companies are erecting the buildings, and will rent them to their employees at the nominal sum of 10 francs (about 85 cents) per month. This is for a two-story brick house. It will be interesting to see what effect this policy has on the relations between employer and employee. At first sight it may appear to have the advantage of always keeping the miners contented through their low rental, but on the other hand it leaves open the question of whether they may be paying indirectly, through lower wages or otherwise, and ultimately giving the companies a fair return for the money invested in housing. I should expect this policy to work better in Germany, where the workmen have long been accustomed to obedience and paternalism. The French, on the contrary, as I know them, may not prove so docile; and I have wondered what the French miners may think and do when they find themselves in the permanent position of tenants on company-owned property.[16]

War Damage Compensations

I had not been long in Europe before I got the impression that reparation payments in France, particularly the sums awarded as compensation for war damage, are quite often in excess of the value of the actual loss. That this was well founded is proved by the fact that recently the French press has been active in denouncing this harmful practice. In the latter part of July, 1922, I read of a typical case where an industrial had put in a large claim for relatively small damage and his claim was accepted. This case is now being dealt with by the French judicial authorities. Shortly after this I noted in the London *Financial Times* for July 31, 1922, the following item under the caption "Huge Expenditures":

"It is computed that the French Government has spent between 80 and 90 billion francs in reparations which are considered as 'a financial advance to Germany,' but it would be interesting to know what percentage of the amount could have been economized by a more practical control over the spending department. An enormous amount has been squandered unnecessarily, not to speak of the amount which, up to a year ago, went into the pockets of dishonest architects and other intermediaries to whom the war-devastated districts have been as a 'land flowing with milk and honey.'"

I may add that in the course of conversation with responsible authorities I have learned that the French Government is actually engaged in correcting these erstwhile abuses.

Other articles on this subject by Mr. Negru will appear in subsequent issues.

[16] In X, a German company-owned town, the barber told me with pride that he is the only independent tenant as far as employment is concerned. The social welfare work for German employees has contributed greatly to developing what is, in reality, a bonded working population.

Cracking Processes for Petroleum

The growing demand for greater gasoline production in order to satisfy the increasing demand for motor fuel has given rise to numerous tried and experimental cracking processes for increasing the yield of gasoline from crude oil. The National Petroleum Association in its Bulletin 134 has recently published the following compilation of the best-known processes which are being used successfully in the refineries of the mid-continent field, classified by inventor, owner and method:

Burton—Standard Oil Co., Indiana; pressure.
Hoover—Hoover Co., Chicago; catalytic.
Cross—Gasoline Products Co., New York; pressure.
Dubbs—Universal Products Co., Chicago; pressure.
Coast—Cosden & Co.; pressure.
Cherry—C. & C. Development Co., Kansas City.
Jenkins—Jenkins Petroleum Process Co.; pressure.
Fleming—Richard Fleming Co., New York.
Ramage—Barnsdall Corporation, New York.
Rittman—United States Government; pressure.
Greenstreet—Pressure.
Ellis—Standard Oil Co. of New Jersey.
Isom—Sinclair Refining Co.; pressure.
Alexander—
Adams—Texas Co.; pressure.
Holmes—Texas Co.; pressure.
Parker—American Gasoline Corporation; pressure.
Blaisdell—Mutual Oil Co.; pressure.
Von Tilberg—Pressure.
Ormonde—Pressure.

The chief refineries of the country using cracking processes successfully are as follows:

Cosden & Co., Tulsa, Okla.—*Coast.*
Barnsdall Refining Co., Barnsdall, Okla.—*Ramage.*
Globe Oil & Refining Co., Blackwell, Okla.—*Cross.*
White Eagle Oil & Refining Co., Augusta, Kan.—*Burton.*
Sterling Oil & Refining Co., Wichita, Kan.—*Fleming.*
American Gasoline Corporation, Kansas City, Mo.—*Jenkins* and *Parker.*
Lakeside Petroleum Co., Augusta, Kan.—*Jenkins.*
Roxana Petroleum Co., Wood River, Ill.—*Dubbs* and *Cross.*
Texas Co., Port Arthur, Tex.—*Holmes.*
Midwest Refining Co., Casper, Wyo.—*Burton.*
Standard Oil Co., Neodesha, Kan.—*Burton.*
Standard Oil Co., Whiting, Ind.—*Burton.*
Sinclair Refining Co., E. Chicago, Ind., and Whiting, Ind.—*Isom.*
Indian Refining Co., Lawrenceville, Ill.—*Cross.*
Atlantic Refining Co., Philadelphia, Pa.—*Burton.*
Pure Oil Co., Heath, Ohio—*Cross.*
Petroleum Refining Co., Latonia, Ky.—*Cross.*
C. & C. Developing Co., Kansas City, Mo.—*Cherry.*
Mutual Oil Co., Chanute, Kan.—*Blaisdell.*
Gulf Refining Co., Port Arthur, Tex.—*Alexander.*
Humble Oil & Refining Co., Houston, Tex.—*Burton.*
Aetna Refining Co., Louisville, Ky.—*Ormonde.*

Nickel Steel for Locomotive Connecting Rods

Connecting rods of 3 per cent nickel steel are installed on about 1,400 locomotives on the North-Western Railway of England. Most of these engines are equipped with Joy's valve gear, which is driven by a link working off the connecting rod. Bending of the rod at this link connection has been frequent—about fifty replacements per year being recorded from this cause. Two recent breakages of such nickel steel connecting rods, occurring while the engines were operating at high speeds, are exciting much comment in the British engineering periodicals. One was doubtless due to a large flaw in the rod; it is suspected that the other was caused by a local heating of the rod in a railroad smithy. This is strictly against regulations, which forbid local shops from doing any work whatever on nickel steel rods. It appears as another instance of the extreme care which must be exercised to prevent abuse of alloy steel, pending the time when mechanics are sufficiently educated to handle it intelligently.

Standardization Of Enameled Apparatus For Chemical Purposes*

By Emerson P. Poste
Director of Laboratories, Elyria Enameled Products Co.

Standardization as Regards Types of Enamels to Withstand Varying Degrees of Corrosive Action—Materials of Construction, Uses, Methods of Temperature Control

ALTHOUGH the manufacture of enameled equipment for the chemical industries is a relatively new development in this country, it has advanced to a stage that warrants consideration from the point of view of standardization. Further experience in its construction and use will secure the well-merited place which it has already gained among the available types of apparatus for the carrying on of the more exacting chemical operations.

Standard Enamels

The enamels which are used in the chemical and allied industries differ in certain respects from those used for ordinary household ware. A piece which is to serve as a domestic culinary utensil or a sanitary fixture need not have a high chemical resistance, but should possess a particularly pleasing appearance by way of color, gloss and opacity. The raw materials which promote these qualities often do so at the expense of chemical resistance. Heavy metal oxides are commonly used. But for chemical work proper resistance without the use of heavy metals is the prime requisite. A pleasing appearance is desirable, but is of secondary importance.

Corrosive Action Classified According to Relative Severity

Commercial experience has caused the manufacturer of enameled apparatus to offer to the trade a series of enamels with chemical properties suited to the several demands of the industry. From a chemical standpoint these enamels may be considered in four classes, thus divided by the demands made for them.

Neutral or Very Slightly Corrosive Materials

The mildest set of conditions which enameled ware may be called upon to meet involves the handling of materials which are not markedly corrosive but do become discolored or contaminated by contact with the ordinary metals of construction. This grouping includes neutral solutions in general, those slightly acid on hydrolysis, a great variety of organic compounds and a group of materials such as chlorine gas which, in the presence of traces of moisture, react with metals. Enamels of this type have given satisfactory service in connection with the following typical substances: oil during deodorization, alcoholic extracts, aniline hydrochloride, ammonium nitrate during evaporation and fusion, bleach liquor, chlorine gas, dry hydrogen chloride gas, hydrogen peroxide, tincture of iodine, phenol, salicylic acid, acetic anhydride, dry sulphur dioxide, tannic acid, bromine.

Weak Acids

In the second classification conditions demand an enamel with a sufficient chemical resistance to serve under more definitely acid conditions with particular reference to the organic acids as a whole, and traces of free mineral acids. The group also includes solutions definitely acid on hydrolysis. As a general case a metal container would be actively attacked, resulting not only in the contamination of the product being handled but in the gradual destruction of the apparatus. Typical cases of satisfactory service in this class are the following: ammonium sulphate, inversion of sugar, citric and tartaric acids, acetic acid, acid brines, moist chlorine, tin chloride with traces of free hydrochloric acid, zinc chloride, mixed acids relatively low in water content.

Resistance to Strong Acids

The third classification involves resistance to all mineral acids with the exception of hydrofluoric. Contact with a metal container would cause a very rapid destruction thereof. Conditions of more severe acid nature not named in connection with the former classes naturally fall here. Typical cases include hot hydrochloric acid, nitric acid, dilute mixed acids.

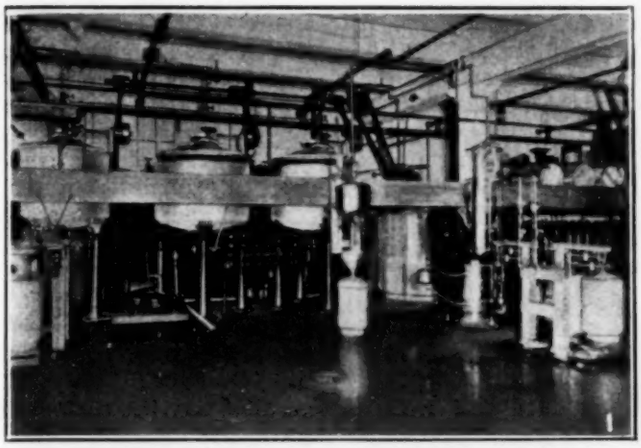
Resistance to Alkalis

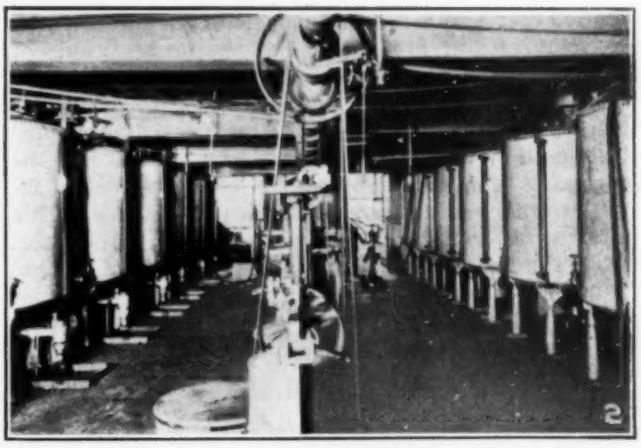
The fourth point as to chemical resistance of enamels is that of the relation to alkalis. As a general statement it may be said that acid resistance of enamels is promoted by the use of materials which are subject to action by alkali. Experience has shown that ammonia has no appreciable effect on enamels. The hydroxides of the alkaline earths are somewhat active. The free hydroxides of sodium and potassium are quite active, excepting at very low concentrations and in the absence of water. Caustic soda solutions under 5 per cent in strength have been successfully stored in enamel-lined units. The carbonates of sodium and potassium can be safely handled over quite a range of concentrations. Sulphides of these bases are quite active. In general enamels are not particularly resistant to alkali.

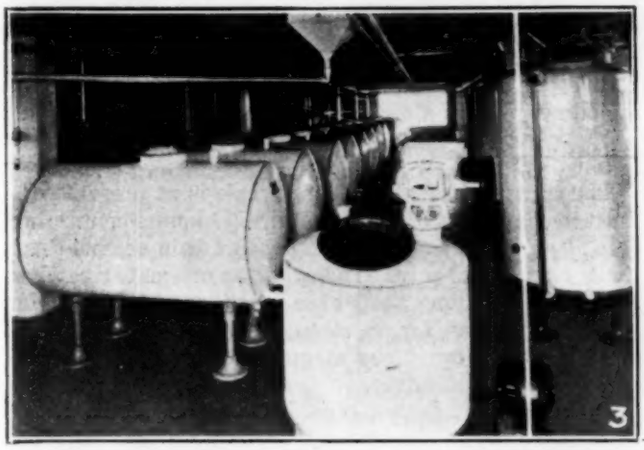
Factors Influencing Choice of Enamel

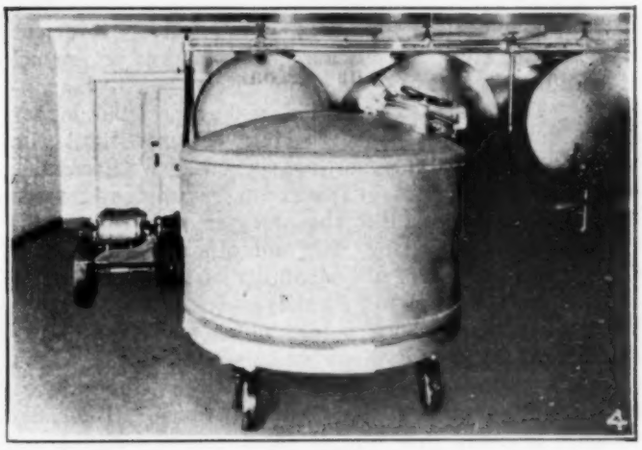
The foregoing consideration has been general. It is difficult to reduce the situation to definite standards. Matters of temperature, type of unit, limitation of size, complication of design and manner of use must be considered in a given case. The more severe the chemical conditions and the more resistant the required enamel the more difficult is the production of a satisfactory unit. Demands of increasing chemical severity, therefore, must be met by smaller units, simpler designs and more careful operation. A condition that may be safe at atmospheric temperature will be far more difficult at higher temperatures. Conditions that are mild at 50 lb. steam pressure may be chemically out of the question at a pressure of 200 lb. A solution successfully handled by one type of enamel in an open unit may give off vapors more active than the liquid itself, necessitating the use of a more resistant enamel in a closed unit. Each case must, therefore, be treated by itself. A statement of the essential chemical conditions by the pro-

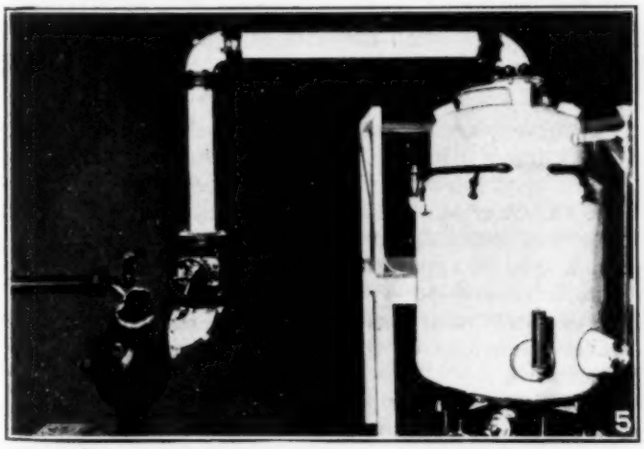
*Paper presented at the Eighth National Exposition of Chemical Industries, Ceramic Day, Sept. 15, 1922.

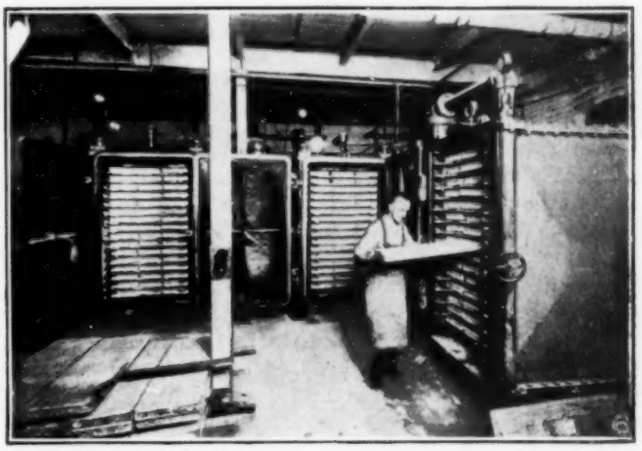


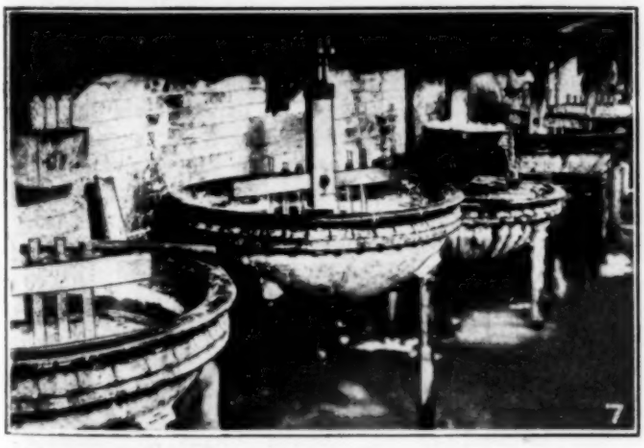












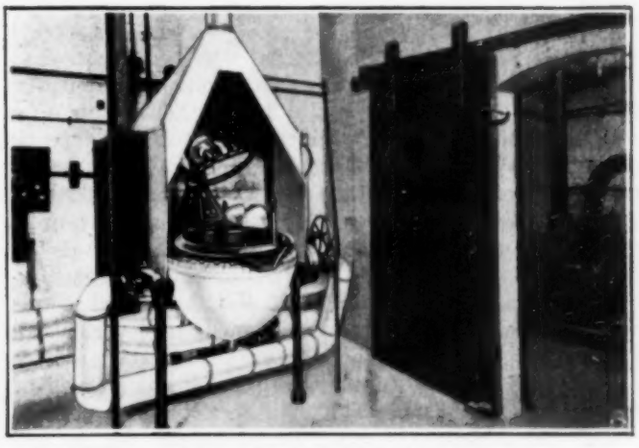


Fig. 1—Standard sirup mixing tanks.
Fig. 2—Vertical mixing and storage tanks.
Fig. 3—Storage tanks; mixing tank.
Fig. 4—Factory transportation unit with agitator.
Fig. 5—Standard vacuum pan.
Fig. 6—Enameled trays in shelf drier.
Fig. 7—Jacketed evaporating dishes.
Fig. 8—Tilting reaction kettle with agitator.

spective user and a careful analysis of the situation by the manufacturer are required if the proper grade of enamel is to be furnished on apparatus of correct design.

One may logically ask why the most resistant enamel is not used on all types of ware. As a general rule the processing temperature of enamel of a given class increases with an increase of chemical resistance. This in turn greatly multiplies the manufacturing difficulties and limits the maximum size and flexibility of design. To use an enamel of more than the required resistance puts an unnecessary burden on the manufacturer and in turn a higher price on the product.

Standard Constructions

As a whole there are two standard types of construction used in the manufacture of enameled apparatus. The one involves the application of a relatively thin coat of enamel to steel, the other a thicker coat of an enamel of a different type to cast iron. Each has its advantages. The steel construction makes possible larger units, but certain manufacturing features limit the larger sizes to mild conditions of use. With smaller pieces more resistant enamels can be used and more severe service met. But the cost per unit volume increases with decreasing size and other features contribute to the relative undesirability of very small units of steel construction for chemical work. On the other hand, there are various points which make the manufacture of smaller cast-iron units very feasible. As a class cast-iron enamels process at lower temperatures than steel enamels of the same resistance. Other details go to make this type of construction desirable on certain lines of work. Some manufacturers furnish steel equipment only, others cast iron only, and still others follow both lines.

Standard Uses

The classification of enameled apparatus from the point of view of the chemical operation to be carried on therein is difficult because chemical manufacturing processes deal with such a variety of substances and treatments. It is more logical to consider the standardization of enameled units from the point of view of the mechanical operations being performed therein.

In classifying enameled apparatus in accordance with the mechanical use, five headings may be considered: mixing, storage, transportation, evaporation, and reaction. These standard operations will be considered with reference to the grades of chemical conditions previously outlined.

Mixing

The mixing problem may range from the rapid dissolving of a solid in a liquid to the formation of a difficult emulsion. The batch may be a few gallons or as large as 7,000 gal. Chemically it may only be required to keep from contact with steel a product which would be discolored thereby; or possibly acids are present which would rapidly eat through the unit at the minutest metallic contact. For mild service large mixers with complicated agitators of wood or special metals are possible. Conditions of intermediate severity call for smaller units and the use of an agitating device coated with enamel, contact with even small areas of the relatively resistant alloys often not being permissible. Such agitators must be of simple design and operated from the top of the unit. With the most corrosive compounds still smaller units of very simple design must be supplied to assure a satisfactory piece of machinery. The mixing unit may be a single-shell tank or it may have a jacket or other device for temperature regulation. It may be of an open or closed top construction.

Typical mixing problems that are successfully met with the proper design of enameled equipment are the following: Mixing of face creams and tooth pastes, preparation of cod liver oil emulsions, mixing of phosphate sirups containing free acid.

Storage

Enamel-lined storage tanks are subject to the same general controlling factors as mixing units. They may be horizontal or vertical as desired. A large variety of accessories are possible for tanks for mild conditions, while severe acids must be met with simpler constructions.

Among typical materials stored are the following: Edible oils, sirups, elixirs, perfumes, extracts, tincture of iodine, phenol, alcohol, c.p. mineral acids.

Transportation

The transportation on a large scale is at present confined to conditions of a mild nature. Liquors containing free organic acids are being transported in enamel-lined tanks on railroad cars. The carrying of smaller batches of liquid from one part of a plant to another is an accomplished fact for all classes of chemical conditions. Open or closed top tanks mounted on trucks or castors find a ready application.

Typical cases of this type include the conveying of chlorinated organic compounds containing free chlorine, the distribution of alcohol to various departments, and the carrying of small amounts of mineral acids about the plant.

Evaporation

In presenting the use of enameled units for the evaporation of liquids it is well to have clearly in mind the fact that the evaporation to dryness of large quantities of material, or the rapid concentration of large volumes of solution, cannot be successfully accomplished in this type of apparatus. These problems fall to the drum drier and other relatively complicated devices. The enameled unit has for its field the handling of smaller quantities of the more sensitive or corrosive products.

The simple evaporation problems are accomplished in open units. Evaporation in closed units is usually of the vacuum type. The destructive acids are generally confined to the pan. A variety of accessories may be used on larger evaporators for mild service, but the unit for severe acids must be far more simple.

Distillation, a special case of evaporation, may be carried on at atmospheric or reduced pressures. The pan is essentially the same as the closed evaporator. The condenser and receiver are enameled excepting where severe acid conditions or substances sensitive to metallic contact are confined to the pan. Copper condensers are sometimes permissible.

Another evaporating unit which is finding a growing application in the chemical trade is the enameled tray for the evaporation of liquids or the drying of moist solids. These are used in both atmospheric and vacuum evaporation.

The installations of various forms of enameled evaporators are numerous. A few typical examples will suffice: The evaporation and crystallization of c.p. salts

such as thorium nitrate, sodium iodide and copper chloride, the vacuum concentration of fruit juices, concentration and fusion of zinc chloride, preparation of hydrosulphite stripping compounds, concentration of aluminum chloride, evaporation of acid rare-earth bromide solutions.

Reaction Units

As reaction units are classified those pieces of apparatus in which specific chemical reactions such as nitration or neutralization are carried on. They may be of a great variety of types as conditions demand—open or closed, plain or jacketed, large or small. Typical installations involve the chlorination of organic compounds, reduction by metals and acid, preparation of silver nitrate from metal and nitric acid, salting out of dyes, generation of hydrocyanic acid, manufacture of ethyl chloride, processing of acid sodium phosphate, manufacture of so-called "phenol condensation" products.

Standard Temperature Control

Problems of temperature control may involve heating, cooling, or holding at a given temperature.

Heating by Steam

The heating of the contents of an enameled unit is accomplished in various ways. Steam under pressure may be passed directly into the material or it may be applied externally by means of a jacket around the tank or by coils within the tank.

If a jacket is used the permissible pressure is a matter of particular importance from an enamel point of view. Steel has an elasticity by virtue of which it can safely "breathe" due to pressure changes. But the less elastic enamel cannot follow such a movement of the steel without rupture. (This point should not be confused with the relative thermal expansion of enamel and steel, to be considered later.) A safe working pressure for an enameled unit may be taken as about one-half of that which would be reasonable for the same structure unenameled. In the case of jacketed vacuum units proper correction for vacuum must be made.

If the permissible jacket pressure under a given case does not furnish the desired temperature, superheating may be resorted to.

Under chemical conditions which will permit the use of metal steam coils within the batch, more rapid evaporation or higher temperatures can be thus realized by using high-pressure steam. Such coils are commonly furnished in plain copper, nickel-plated, tinned or silver-plated copper, or aluminum.

Oil Heating

Certain types of reactions demanding high temperatures but relatively low heat absorption are often made possible by the use of oil as a heating medium. Oil heated in a separate heater may be circulated through the jacket or through metal coils within the batch. Oil in the jacket may be heated by direct fire applied to the bottom of the jacket or by high-pressure steam in coils within the jacket. Specific conditions, chemical and mechanical, will govern the procedure in a given case.

Molten Alloy Bath

Some reactions demand higher temperatures than can be obtained by steam jackets, a more rapid flow of heat than would result from the use of oil as a heating medium and involve chemical conditions such that metal coils are out of the question. Such situations have been successfully met by the use of a bath of molten alloy, heated by a fire beneath.

Direct Fire

A final possibility for the production of high temperatures is the use of direct fire. As a general rule this method is undesirable. Enamels of the proper composition have a thermal expansion so related to that of the metal beneath that the two materials can pass through a reasonable temperature change without the setting up of strains causing rupture of the enamel. But if the temperature change is severe and local, trouble may result. No conditions existing with permissible steam pressures or oil-heating temperatures should cause distress. But with direct fire the heating is likely to be locally excessive, causing severe strains on sudden changes of temperature. Under conditions of evenly applied heat, accomplished by proper checkerwork or baffles, very satisfactory service can be realized. Small units heated over a flame of low intensity applied to a large portion of the dish are found to be very practical. If the material being treated has a relatively low thermal capacity—for instance, an oil as compared with an aqueous solution—conditions of excessive strain from direct fire heating are less likely to be produced.

Cooling and Insulating

The problem of the cooling of a liquid is not frequently encountered. In a few cases cold water or brine have been circulated through jackets or coils. Condensers are usually equipped for the circulation of water or brine.

It is often desired to prevent the rapid exchange of heat between a unit and the atmosphere. Air confined in a jacket or the use of the common insulating materials are frequently resorted to.

Rate of Heat Transfer

A statement as to the rate of heat transfer through enameled metal is pertinent. The partition through which heat is called upon to pass may range from a thin coat of enamel on ⅛-in. steel to a relatively thick coat on 1-in. cast iron. Hence the rate of heat transmission varies between quite wide limits. As a maximum it is approximately one-half, and as a minimum about one-fifth that of copper. These values are on the assumption that the same conditions as to temperature difference, velocity and other factors exist. The comparison also refers to copper of the thickness used in the construction of apparatus for similar operations.

Conclusion

Thus it is seen that by the combination of various standard elements of design, enamel, method of temperature control and accessories, equipment can be constructed to serve a great variety of purposes. While a given piece of apparatus may differ from any previously made, it usually embodies only standard features assembled to meet a particular case. The would-be purchaser does well, therefore, in recognition of these facts, to submit his case clearly and fully so that the manufacturer may intelligently make such a combination of standard elements as may best suit the uses to which the apparatus is to be put.

Elyria, Ohio.

Manufacture Of Alloy Steel for Airplane Shafts*

Experiments on the Manufacture of Nickel-Chromium Steel in the Basic Heroult Furnace—To Produce Airplane Shafting With No Trace of Transverse Structure, It Is Necessary to Use Very Good Raw Material and Refine With Two Oxidizing Slags as Well as the Usual Carbide Slag

By Dr. E. Kothny

INCREASING demands upon steel of quality, used in motor car and airship construction, require continual improvement in the metal. Its properties depend primarily upon the care used in its manufacture. Subsequent treatment during fabrication may spoil a good steel, but can never correct errors occurring prior to the ingot.

Furnace Investigations

It is by no means easy to investigate the influence of a particular step in the furnace operation. In our present state of knowledge this is best done in an empirical manner—by taking a series of heats, worked as nearly alike as possible except for one factor, which may be varied within reasonable limits. In the studies reported herewith, ingots made in this way were worked up into finished pieces in the regular manufacturing routine, and a study of the qualities of these finished pieces gave useful information on the effect of the variable under consideration.

Our regular melting practice on nickel-chromium steel was as follows: A heat is melted in a 2½-ton basic Heroult furnace from a cold charge of selected plain and alloy scrap in such a way that when molten the P, Mn and C are removed by an oxidizing slag. After these elements are low, the slag is removed, the bath recarburized with petroleum coke and a white slag prepared to deoxidize and remove sulphur. After the proper white slag is obtained, FeMn and FeSi are added to complete the deoxidation, whereupon FeCr is added. The furnace is tapped after holding it for a period of time depending upon the temperature of the heat.

Influence of Time of Solidification

One such heat was first used to determine the joint influence of deoxidation and time of solidification. To make sure that the heat was overoxidized, two oxide slags were made up, each of which contained an excess of ore. After the second had been skimmed and the white slag melted, only enough FeMn and FeSi were added to remove red shortness. One-half of the heat (Part A) was tapped immediately, so the influence of the deoxidizers was a minimum in this part. A second test taken of the metal remaining in the furnace (Part B) showed slight red shortness, so a little more FeMn was added, the current switched on for 30 minutes, and the furnace then drained.

We then had two ladles of metal, "A" poorly deoxidized and "B" well deoxidized. Analyses were identical (C 0.40, Mn 0.42, Si 0.22, P 0.03, S 0.015, Cr 0.48 and Ni 2.54) except Part B had 0.50 per cent Mn. Each ladle poured three ingots: (1) in a preheated sand mold, (2) a cast-iron mold at 400 deg. C. and (3) a cast--iron mold at 50 deg. C. Both ladles were poured at a low temperature—a skull was left in each. All ingots were big end up, tapering from 25 to 23 cm. on a side, 1.1 m. long. Each had a sinkhead, and charcoal was placed on the ingot to prevent rapid freezing at the top. All ingots settled during freezing and were dense except A2 (poorly deoxidized metal in a hot iron mold), which rose slightly and showed blow-holes at the upper edges.

By probing with 4-mm rods the time of solidification was noted, as follows:

A1	35 min.	B1	35 min.
A2	15 min.	B2	15 min.
A3	13 min.	B3	13 min.

Preheating the iron mold has no real difference, since A3 and B3 were cast last and coldest and should be expected to freeze somewhat quicker. Sand-cast ingots A1 and B1 solidified suddenly once freezing started, but those made in iron molds solidified gradually from the edge to the center and from the bottom upward.

Tests on the Ingots

All the ingots were nicked and broken in the lower third. A1 and B1 had the same fracture: coarse crystalline over the whole area, with no difference edge to center. A2 and B2 were also alike: coarse granular in the center, but columnar at the rim. A3 and B3 both revealed thin, leafy or laminated crystals throughout, reminding one of low-carbon ferrochromium. Thus the ingot structure as revealed by fracture was independent of the state of deoxidation.

A slice cut immediately back of the fracture was smoothed and pickled 24 hours in 1:1 HCl (arsenic free). Again the deoxidation practice failed to make a difference: A1 and B1 (cast in sand molds) showed a slightly porous texture, due to the sudden solidification, except about the rim, which was dense for a depth of 1.5 cm. All ingots cast in iron molds were dense throughout.

Tests on Heat-Treated Bars

Nickel-chromium steel of this analysis is ordinarily used only after working and heat-treatment. Its acceptance is based upon proper tensile and impact values and a fibrous fracture, both longitudinally and at right angles to the direction of working. Therefore the lower third of each ingot was reduced 79 per cent to a billet 11 cm. square, it having previously been found that a 65 per cent reduction was sufficient to develop the best physical properties. Temperatures (by optical pyrometer) were 1,050 deg. C. at beginning of rolling and 1,000 at end. All pieces rolled well.

Test specimens were cut from each of these small billets after they had been annealed 10 hours at 700 deg. C. (Forged pieces of Ni-Cr steel are usually an-

*Abstracted from *Stahl und Eisen*, Jan. 8, 1920, p. 41, and May 20, 1920, p. 677.

TABLE I—TENSILE AND IMPACT TESTS

Ingot	Piece	Yield Point, Lb. per Sq. In.	Ultimate Tensile Strength, Lb. per Sq.In.	Elongation, Per Cent	Contraction, Per Cent	Notch Toughness, Kg.-m.	Fracture of Impact Tests
Longitudinal Test Specimens							
A1	Bottom	107,000	122,000	11.9	60	13.6	Fibrous at rim, granular in center; flows poorly.
	Top	107,000	122,000	11.6	60	14.0	
B1	Bottom	108,000	122,000	11.0	50	17.15	Fibrous; flows very well.
	Top	111,000	122,000	11.6	60	18.30	
A2	Bottom	107,000	122,000	11.0	60	16.5	Part granular; flows well.
	Top	105,000	121,000	11.5	61	15.9	
B2	Bottom	108,000	124,000	11.4	60	17.5	Granular; flows very well.
	Top	107,000	125,000	11.3	61	16.9	
A3	Bottom	107,000	122,000	11.2	60	15.0	Part granular; flows well.
	Top	107,000	124,000	11.5	61	15.6	
B3	Bottom	105,000	121,000	11.6	60	16.5	Fibrous; flows very well.
	Top	107,000	124,000	11.5	61	17.0	
Transverse Test Specimens							
A1	.....	122,000	135,000	3.9	14	2.33	Flows poorly, pronounced transverse splintering, scattered grains.
B1	.....	125,000	137,000	3.2	14	2.5	Pronounced transverse splintering, fibrous, flows poorly.
A2	.....	118,000	134,000	7.2	24	3.1	Faint transverse splintering, partly granular, flows poorly.
B2	.....	117,000	132,000	8.4	25	3.5	Faint transverse splintering, fibrous fracture, flows well.
A3	.....	119,000	135,000	7.5	23	3.0	Faint transverse splintering, partly granular, flows poorly.
B3	.....	117,000	134,000	7.9	27	3.5	Faint transverse splintering, fibrous fracture, flows well.

TABLE II—FRACTURES OF ANNEALED BARS

Ingot	Broken Across the Grain	Broken With the Grain
A1	Center granular; fibrous at rim; loose structure; flows poorly.	Pronounced transverse splintering faintly granular; small ability to flow.
B1	Fracture fibrous and loose; flows well.	Pronounced transverse splintering; fibrous fracture throughout; small ability to flow.
A2	Fracture about two-thirds granular; flows well.	Transverse splintering; partly granular; flows well.
B2	Fibrous fracture; flows very well.	Transverse splintering; fibrous fracture; flows well.
A3	Fracture partly fibrous; flows well.	Faint transverse splintering; partly granular; flows well.
B3	Fibrous fracture; flows very well.	Faint transverse splintering; fibrous fracture; flows well.

nealed for machinability and to relieve internal stresses before final heat-treating, and test-pieces should be put through the same program.) Two pieces 5 cm. square and 25 cm. long were taken in a longitudinal direction, and two slices 3 cm. thick across the section. Longitudinal test specimens were turned to 10 mm. diameter and the transverse specimens 8 mm., with length between gage marks equaling $11.3\sqrt{\text{Area}}$. Longitudinal impact specimens were 2 cm. square, notched 5 mm. deep ending in a round hole 4 mm. in diameter. In the testing machine the anvil was set so the specimen was broken as a beam with 120 mm. clear span. Corresponding dimensions of the transverse impact specimens were: 1 cm. square, notched 2 mm. with angular groove at 45 deg., and broken on a 7-cm. span.

All test-pieces were water-quenched from 820 deg. C.; the longitudinal pieces drawn at 600 deg. C. for 15 minutes and the transverse at 500. Results are given in Table I.

Fractures were determined by taking the annealed 5-cm. bar ends, and 3-cm. slices (from which the test specimens were machined), notching them 5 mm. deep, and breaking under a steam hammer. Results are given in Table II.

Although steel such as this is rarely used in the annealed state, it was thought that physical tests would give some light on the subject. Therefore test-pieces were cut from the annealed 11-cm. billet, giving values shown in Table III.

Discussion of Results

Comparing A1 with B1, A2 with B2 and A3 with B3 in Table III shows that there is no great difference in the mechanical properties and fractures of poorly and well-deoxidized steel billets in the annealed state. There is also no difference in the longitudinal samples of steels slowly and quickly cooled (compare A1 and A3, etc., Table III); however, transverse test-pieces of the slowly solidified steel show a pronounced transverse splintering and an undesirable loose structure. To bear out these conclusions, annealed billets were smoothed and pickled. A2, B2, A3 and B3 showed a perfectly dense structure. Slowly cooled ingots A1 and B1 showed a slightly porous structure in the center and a dense structure at the rim, 15 mm. deep; despite reduction of nearly 80 per cent, the cavities in the ingot had not been closed.

As to the heat-treated specimens, Tables I and II show that the quality of the quickly solidified and well-deoxidized steel B2 and B3 is most excellent. Although the poorly deoxidized steel would pass ordinary tensile and impact requirements, the granular fractures appearing in whole or in part would be cause for great suspicion. These tests seem to show that poor deoxidation practice induces partly granular fractures in heat-treated bars, but fails to show observable differences in the fracture or macrostructure of the ingot or of the annealed bars, or in the tensile and impact properties of the latter.

Speed of solidification affects the quality to a far greater extent. It causes differences in all the tests recorded. Especially in the rolled bars, the slower the steel solidifies the more pronounced is the transverse structure or splintering (*cf.* B3 and B1, Table I). In order to avoid this last-named defect, it has become

TABLE III—PROPERTIES OF ANNEALED BILLET

Ingot	Yield Point, Lb. per Sq.In.	Ultimate Tensile Strength, Lb. per Sq.In.	Elongation, Per Cent	Contraction, Per Cent	Notch Toughness, Kg.-m.	Impact Fractures	Character of Tension Fracture
Longitudinal Tests							
A1	60,000	88,000	19.0	61	15.7	Faintly granular, fibrous at rim, flows well	Partly fibrous, flows well, loose fracture
B1	71,000	98,000	17.6	58	14.6	Granular, fibrous at rim, flows well	Partly fibrous, flows well, loose fracture
A2	60,000	90,000	18.3	58	15.0	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
B2	65,000	98,000	17.5	61	14.5	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
A3	61,000	91,000	18.5	60	15.2	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
B3	67,000	98,000	17.6	58	15.0	Granular, fibrous at rim, flows well	Granular, fibrous at rim, flows well
Transverse Tests							
A1	60,000	85,000	9.8	24	4.04	Fibrous with grains, pronounced transverse splintering, flows well	Fibrous with some grains, pronounced transverse splintering
B1	65,000	88,000	7.2	16	3.60	Fibrous with grains, pronounced transverse splintering, flows well	Fibrous with some grains, pronounced transverse splintering
A2	57,000	87,000	15.4	38	5.36	Fibrous with some grains, flows well	Same as fracture of impact test
B2	64,000	91,000	14.5	40	5.40	Granular, fibrous at rim, flows well	Same as fracture of impact test
A3	60,000	87,000	12.0	35	5.20	Granular, fibrous at rim, flows well	Same as fracture of impact test
B3	64,000	90,000	13.5	37	5.45	Granular, fibrous at rim, flows well	Same as fracture of impact test

our practice to pour alloy steels at as low a temperature as possible.

Steel for Airplane Shafting

Austrian army specifications for airplane motor shafting call for the following mechanical properties, when made on pieces of dimensions given above:

	Longitudinal Test Lb. per Sq.In.	Transverse Test Lb. per Sq.In.
Elastic limit, maximum	156,500	156,500
minimum	135,000	135,000
Ultimate strength maximum	170,700	170,700
minimum	149,500	149,500
Difference between the two above (maximum)	14,200	14,200
Elongation, minimum	7 per cent	4 per cent
Contraction, minimum	45 per cent	15 per cent
Notch toughness	8 kg.-m.	2.5 kg.-m.

All fractures, and the nick and bend test, shall show a full fibrous structure, and a good ability to flow.

When called upon to make this material in large quantity, we first selected some blooms from our stock analyzing C 0.20 per cent, Mn 0.4 to 0.6, Si 0.2 to 0.3, Cr 1 to 1.5 and Ni 4 to 4.5 and made up some shafts therefrom. All tests were passed with ease, the transverse tests showing 170,500 lb. ultimate, 6 per cent elongation, 36 per cent contraction, and impact value of 6 kg.-m. Broken tensile test-pieces and the nick and bend test could scarcely distinguish between longitudinal and transverse fractures. Thereupon a number of electric furnace heats of that analysis were made, but unfortunately the steel did not give a good fibrous fracture, although the other mechanical tests were easily met.

These defective heats were made in what was thought to be substantially the same manner as the practice which produced the metal in stock (outlined in the early part of this article). As far as known, the kind of metal charged was the only difference—the older, successful metal was made of Styrian plate scrap, while the defective heats were made of electric steel scrap from our own plant. The latter was very low in phosphorus, in contrast with the plate scrap, consequently only one oxide slag was necessary to keep this element down. Judging from the experiments given in the early part of this article, two oxide slags—such as are necessary for impure Styrian scrap—would result in a harmful overoxidation of the bath. Our efforts to produce acceptable metal therefore led us first to investigate the influence of the charge upon final quality.

Influence of the Charge

A fairly large quantity of uniform scrap of highest quality was available, being, in fact, electric steel of our own manufacture. Five identical charges were made up, each consisting of Ni-Cr steels having 4 to 4.5 per cent nickel. Five other charges were made up of carbon tool steel—to these the required nickel was added directly after melting. In this way we determined that it apparently made no difference whether the nickel was residual in the melt or was added separately.

A sample taken immediately upon melting showed that all ten heats were very hard, therefore ore was added sparingly. As soon as the heats were sufficiently soft—the last samples were red short—they were deoxidized with FeMn. This addition was made before slagging off so that the deoxidation stage might be as long as possible. Immediately after slagging off FeSi was added to the bare bath and a white slag made up. After 30 minutes a sample would always show red shortness and FeMn and FeSi were added until red shortness disappeared. Thereupon FeCr was added. Ten minutes later the current was switched off.

Deoxidation with FeMn before slagging off caused unduly high manganese in the final analysis, since more FeMn had to be added after the white slag had been prepared. Five of the heats were therefore made by the old method—i.e., FeMn and FeSi added after the white slag had acted for 30 minutes.

All heats were slightly overheated; they were held in the furnace 4 minutes before pouring. Our optical pyrometer was less satisfactory than the "spoon" test[1]—the temperature of the bath in these heats was such that 15 to 25 seconds passed before the metal would crust over.

An ingot 16.4 cm. (6½ in.) round from each heat was rolled to 6-cm. square rods. Two slices 25 mm. thick were cut, nicked 5 mm. in the center and hardened in water from 840 deg. C. One was broken in that condition by a single blow from a steam hammer. The other was broken after tempering at 400 to 450 deg. C. (depending upon its hardness) in a lead bath. Ultimate strength was estimated from the size of the Brinell impression.

All these ten heats had a fibrous fracture in the hardened state, but a very objectional granular fracture and poor ability to flow in the tempered condition. Repeating the heat-treatment did not change these results.

We were therefore reluctantly faced to the conclusion that the purest raw material (either with nickel or without it) does not always produce a steel with good transverse properties. Evidently the process of melting or working the heat influenced the quality—since, as it has been indicated, we were assured that we were able to make acceptable steel unknowingly.

Influence of Casting Practice

In order to extend the conclusions reached in former experiments—detailed in the first part of the paper—to high-alloy steel for aircraft, two heats were made of purest electric scrap and poured into 8-in. molds of various sorts and temperatures. It is unnecessary to recount these in detail, since they confirmed our expectation—viz., that long cooling in a sand mold is associated with pronounced transverse structure, and that if iron molds were used, it appeared immaterial whether they were chilled or warm, top or bottom cast. Therefore we held to our standard practice: cool pouring the steel in blood-warm molds.

Tests Taken While Working the Heat

In the hope that the circumstances which determine the structure might be recognized when testing a heat during the working, we took a series of large samples from two heats, immediately after certain additions had been made and also some time later. These samples were poured into 3-in. square molds and forged to a slab 2x10 cm. cross-section under a small steam hammer. Two pieces 5 cm. long were cut from these slabs, notched 5 mm. deep in a longitudinal direction (i.e.,

[1] The spoon used for taking the furnace tests is washed in slag and about 2 kg. melted steel dipped up, and skimmed. A stop watch determines the time required to form a skin on the surface of the steel. Comparative figures result only if all additions have been made. If FeMn alone is in the bath, gases boil up and agitate the surface, so the time recorded is unduly long. If FeCr has also been added, the time is too short, where FeSi increases the time to crust over.

TABLE IV—TESTS DURING WORKING TWO HEATS

	Time	Addition	Sample Taken	Transverse Fractures		Ultimate Strength	
				Hardened	Annealed	Hardened	Annealed
Heat 1	0 hr. 0 min.	10 kg. FeMn					
	0 hr. 10 min.	.....	No. 1	Fibrous, flows well	Fibrous, flows well	163,500	148,000
	0 hr. 13 min.	4 kg. FeMn and 40 kg. FeCr					
	0 hr. 15 min.	.....	No. 2	Slightly granular, flows well	Slightly granular, flows poorly	217,000	166,000
	0 hr. 45 min.	.....	No. 3	Fibrous, flows poorly	Slightly granular, flows poorly	226,000	175,000
	In the ladle	10 kg. FeSi	No. 4	Fibrous, flows well	Fibrous, flows well	227,000	180,500
Heat 2	0 hr. 0 min.	16 kg. FeMn					
	0 hr. 27 min.	.....	No. 1	Flows well, fibrous	Flows well, fibrous	162,000	139,000
	0 hr. 30 min.	20 kg. FeCr					
	0 hr. 34 min.	.....	No. 2	Fibrous, flows poorly	Slightly granular, flows poorly	189,000	156,500
	0 hr. 41 min.	20 kg. FeCr					
	0 hr. 45 min.	.....	No. 3	Fibrous, flows poorly	Slightly granular, flows poorly	220,000	172,000
	In the ladle	10 kg. FeSi	No. 4	Fibrous, flows well	Fibrous, flows well	210,000	172,000

TABLE V—TESTS ON THIRD HEAT

Time	Addition	Sample Taken	Transverse Fractures		Ultimate Strength	
			Hardened	Annealed	Hardened	Annealed
0 hr. 0 min	15 kg. FeMn					
0 hr. 20 min	15 kg. FeMn	No. 1	Fibrous, flows well	Fibrous, flows well	162,000	142,000
0 hr. 23 min	30 kg. FeCa and 18 kg. FeSi					
0 hr. 35 min	30kg.FeCr	No. 2	Slightly granular, flows well	Granular, flows poorly	183,500	166,300
0 hr. 45 min	.....	No. 3	Slightly granular, flows well	Granular, flows poorly	189,000	162,000
0 hr. 55 min	.....	No. 4	Slightly granular, flows well	Granular, flows poorly	189,000	162,000
In the ladle	.....	No. 5	Slightly granular, flows well	Granular, flows poorly	217,500	178,000

parallel to the long dimension of the slab). One was hardened and broken, the other drawn back to the hardness required for airplane shafts, and then broken.

Rather poor sheet scrap was charged for these heats; both were worked with two oxidizing slags. After the second one was skimmed, and the white slag obtained, enough FeMn was added to free the steel from red shortness. The first large sample was taken at this time. Sequence of further additions and samples are noted in Table IV. (It may be noted that in Heat No. 2 the FeCr was added in two parts.) Ferrosilicon was added to the ladle, and the fourth sample taken when pouring the ingots.

Table IV shows that the finished steel of both heats would conform to specification. Intermediate samples show that the steel has a fibrous fracture as long as it contains no chromium; the structure became granular in both the hardened and drawn condition upon adding FeCr and in fact the more granular the higher the chromium.

Time for Adding FeSi

Ferrosilicon, in turn, improves the structure. Could it show a still better improvement when exerting its influence for a longer period?

To determine this point, another heat was made from the same kind of material, but only one oxidizing slag was used. Ferrosilicon and FeCr were added simultaneously to a bath which was relatively cool. A spoon test taken after the second sample (Table V) showed 20 seconds. This increased to 35 seconds just before tapping; consequently the heat was held 10 minutes.

As can be noted from Table V, this heat did not fill the requirements. The only differences in working were the use of one oxide slag and the time of adding FeSi. We concluded that one or the other of these is responsible for transverse structure. Since overoxidization is universally regarded as damaging, we rejected this as an influential factor and turned our attention to the proper way to make the FeSi addition. Other heats were made of the same sheet scrap, and the FeSi added at various times or in the ladle. Results were uniformly bad. As a last resort we then turned to the refining practice.

Thereupon we made two 6-ton open-hearth heats of first-class steel, one containing 5 per cent Ni and the other free of alloy except 0.8 per cent C—otherwise their composition was almost identical. The ingots from these heats were divided into six piles and remelted in the electric furnace. Three of the melts were made with one oxidizing slag, the other three with two; otherwise the practice was identical.[2]

Of the heats made with one oxidizing slag, two developed transverse structure and granular fracture in the rolled, heat-treated rods; the third was fibrous with only a trace of transverse weakness—it alone passed specifications. All three of the heats made with two oxidizing slags passed specifications easily, all having fibrous fractures, flowing well, and in only one was there a faint suggestion of transverse weakness.

These experiments seemed to prove beyond doubt that working a heat of alloy steel with two oxidizing slags, far from being detrimental, actually improves the quality. However, it is not able to produce steel of perfection from quite inferior material, as we very quickly demonstrated when using impure junk. Due regard must be paid to the quality of the charge.

Successful Furnace Practice

In order to avoid rejections in finished airplane shafts, the following practice was adhered to:

Selected scrap of best quality is charged, melted and worked with two oxide slags. (Use ore rather than mill scale.) After skimming the latter, the finishing slag is made up, using 1 kg. FeMn per ton of steel to hasten the reactions and bring the latter white in a minimum of time. When it is white, enough FeMn is added to eliminate red shortness, whereupon FeCr and FeSi are added. When the additions are melted, the heat is well stirred, a 3-in. ingot poured in a chill, and a spoon test for temperature should not take more than 30 seconds to film over. This indicates that the metal should be held in the furnace 5 minutes.

The test ingot is forged to a slab 2x5 cm. in cross-section. Two pieces 2 cm. long are cut off and nicked longitudinally. Both pieces are hardened in water from 800 to 850 deg. C., and one drawn back in a lead pot at 400 to 450 deg. C. If the tempered piece shows a fibrous structure and a good ability to flow, the heat is cast into forging ingots for making airplane shafts.

[2]Steel melted with two oxidizing slags requires an excess of 3 or 4 kg. FeMn per ton to eliminate red shortness. It was found later that the finished steel (which must contain 1 per cent chromium in order to give it the necessary hardening properties) cannot hold more than 0.8 per cent Mn, to avoid granular fractures

If the fracture of the quenched piece only is fibrous, the steel is cast into ingots for rolling. An even better test was introduced later. A piece of the same test ingot is forged to 2 cm. square, notched 5 mm. deep, and heat-treated to 165,000 lb. per sq.in. strength. When broken, the fracture must show no trace of granular structure.

A small test ingot, 6½ in. round, is cast with the remainder of the heat. This is rolled to a 6-cm. square rod. Two slices 2.5 cm. thick are cut from this bar, nicked 5 mm. across the face, and heat-treated to an ultimate strength of 165,000 lb. per sq.in. (as determined from the Brinell test). After breaking under a single steam-hammer blow, the fracture must be fibrous and show good ability to flow. This latter test is somewhat more severe than the furnace test, and will reject occasional heats which might give trouble when making airplane shafting.

No differences in microstructure can be observed in the heats which have granular fracture and those which are fully fibrous.

Legal Notes

By Wellington Gustin

Contract to "Manufacture" May Not Be Termed "Work and Labor" So as to Evade Tax

The Circuit Court of Appeals of the United States has decided that the manufacture of munition parts under a contract and from materials furnished is subject to the munition manufacturer's tax, this finding affirming a decision of the District Court in an action brought by the Dayton Brass Castings Co. against the Collector of Internal Revenue. A certiorari has been denied the Brass Works by the United States Supreme Court, which affirms the lower courts, 277 Federal, 227.

It appears from the facts that the Canadian Car & Foundry Co. had a contract for the sale of shrapnel shells to or for the use of the Russian Government, and had sublet to a machine company at Dayton, Ohio, a contract for making the fuses for the shells. The machine company in turn contracted with the Dayton Brass Castings Co., by which it was to furnish the latter brass ingots which were to be put through the Dayton company's foundry, molding the same into small castings, which were to be united by the machine company with other parts to complete a fuse. For this service the castings company was to receive a specified price per pound.

By the provisions of title 3 of the act of Sept. 8, 1916 (39 Stat., 780) and known as the "munition manufacturer's tax," a tax was imposed upon every person manufacturing "any part of" fuses, the tax to be 12½ per cent of the entire net profits actually received or accrued during the year from the sale or disposition of such articles manufactured within the United States. This tax was imposed upon the castings company, which paid the tax under protest and brought this suit to recover.

Two propositions were considered. One was that, since plaintiff had to do with only one part of the fuse, it was not a manufacturer within the meaning of the act. But the established rule is that one who makes a part which is intended to be and does by the act of another become merged into the kind of munition specified in the act is a manufacturer subject to tax.

Then the plaintiff contended that it did not receive profits "from the sale or disposition of such articles," but was in effect paid only for work and labor expended on the property of another. The court says, taking together the sections of the statute above noted, it concludes that the tax was imposed upon the business of manufacturing, and was measured by the profits received upon the sale or disposition. If there were no profits, the tax would be nothing. That the castings company received profits from its contract was not disputed. While the company did not make "sales" it did make a "disposition" of the articles. Having received the metal and having cast it into form, the company disposed of the castings and so far disposed of the subject matter of the contract as to turn these articles over to the machine company and get payment for its service. This court held to be a disposition.

A very substantial contention against this holding was that under the doctrine of *ejusdem generis* the statutory phrase "sale or disposition" can include only dispositions of the character of a sale. But the court says this rule may not prevail to the exclusion of the other rule which requires every word and phrase to be given force and meaning, if possible. And if plaintiff's contention were right, the statute could be evaded wholly or in very large part by similar contracts to this one, and a court will not sanction such evasion of the law by dividing the manufacturing process into several steps by separate persons.

Antimony Industry of Hunan, China

Hunan has been producing antimony for over 20 years. Discoveries were made as early as 1897, and since that time new ones have been made yearly, according to reports from Consular Clerk Gordon L. Burke, published in *Commerce Reports* for Oct. 9, 1922. The demand during the war greatly exceeded the supply, causing the price to soar to ten times its normal level. Hunan became a large exporting center for antimony, and many mines and smelters sprang up all over the province. The termination of the war resulted in a cessation of the abnormal demand and the price went down to a very low level. The selling price in many cases is still much below the actual cost of production, which has caused about nine out of every ten mines to stop operations. It is believed, however, that the lowest level in the industry has been reached, and that a slight improvement is now to be noticed. By this is meant that the richest mines and the ones that cost the least to operate are now being exploited to their full worth. During 1921 there were 921 mines in operation.

Deposits of antimony are abundantly and widely distributed throughout Hunan. The districts around Packing, Anhwa and Sinhwa are particularly rich in their supply of this mineral. Hsikuangshan, a hill located in the Sinhwa district, is called Antimony Hill because of the richness of the deposits found there. The antimony ore of Hunan is of a very high grade and is free from arsenic and other impurities. The antimony content of the ore runs from 20 to 65 per cent. Regulus exported by the Wah Chang Mining & Smelting Co. is 99.95 per cent pure. The Herrenschmidt process is generally used in extracting antimony regulus. Since the demand for regulus has fallen off, antimony ore is manufactured into trioxide, commonly called antimony oxide.

Distillation and Concentration Of Dilute Nitric Acid

An Experimental Study of the Concentration of Nitric Acid—The Distillation of Water-Nitric Acid Mixtures and of Nitric Acid-Sulphuric Acid Mixtures—Graphic Study of the Results

By E. Berl and O. Samtleben
Translated by F. C. Zeisberg*

Translator's Note: In *Chemical & Metallurgical Engineering*, vol. 25, pp. 1103-6 and 1145-50 (1921) appeared a translation of an article by P. Pascal in *Annales de Chimie* covering a very complete investigation of the distillation of HNO_3 solutions and H_2SO_4-HNO_3-H_2O mixtures. Apparently about the same time Pascal was making his experiments there was under way in Germany an independent investigation of the same problem, the results of which have recently appeared in the *Zeitschrift für angewandte Chemie*. Since the results obtained by the two investigators differed considerably and since the readers of *Chemical & Metallurgical Engineering* had already been made familiar with the earlier results, it seemed desirable to afford them the opportunity to familiarize themselves with the later work also. The following translation has hence been prepared, only such portions of the original article being used as bear directly on the work of Pascal.

FORMERLY nitric acid was manufactured by decomposing Chilean saltpeter with concentrated sulphuric acid. This process was widely developed technically; from the standpoint of distillation in stages by Uebel[1] and the Badische Anilin und Soda Fabrik[2], and from that of operation in a vacuum by Valentiner and Schwartz[3]. The acid obtained by these processes was highly concentrated enough to meet the needs of the industry, and even the weak acid simultaneously obtained in comparatively small amounts was utilized, or, where no use could be found, was returned to the retort with the saltpeter and redistilled. The question of highly concentrating weak nitric acid became most important as the problems of obtaining nitric acid from the oxidation of ammonia and atmospheric nitrogen were solved. Since in the arc process a 35 per cent acid and in ammonia oxidation at best a 55 to 58 per cent acid is obtained, it became necessary, for most uses to which the acid was put, to concentrate it to 48 deg. Bé. or higher. During the war, with the increased demand for highly concentrated nitric acid, particularly for nitrating, the question assumed unusual importance.

By simple distillation of an acid weaker than 68 per cent, even when employing dephlegmators or changes in pressure, a concentrated acid cannot be obtained, because, as Roscoe[4] showed, mixtures of nitric acid and water possess a minimum vapor pressure, or, what is equivalent, a maximum boiling point. At 760 mm. this point lies at 120.5 deg., with 68 per cent HNO_3, by weight, in the liquid and gas phases. As there is here a system of two substances whose liquid phases as well as gas phases are miscible in all proportions, it is possible to achieve by rectification only residues of 68 per cent HNO_3, while the portion that distills over in the case of mixtures weaker than 68 per cent is, with ideal rectification, pure water, and in the case of mixtures stronger than 68 per cent, pure 100 per cent HNO_3.

In the early years of the war the Central Powers,

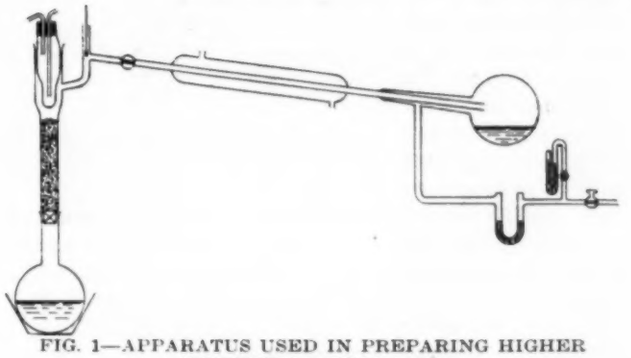


FIG. 1—APPARATUS USED IN PREPARING HIGHER STRENGTH NITRIC ACID

because the high concentration process had not been technically perfected, principally for lack of proper materials of construction, obtained most of their concentrated nitric acid by converting weak nitric acid into sodium nitrate and decomposing this with concentrated sulphuric acid. This method is fraught with an extraordinary consumption of raw materials, since per ton of HNO_3 in the form of 48 deg. acid it was necessary to use 0.8 ton sodium carbonate and 1.5 ton sulphuric acid, producing as byproduct 1.8 tons sodium bisulphate. For this latter there was at first available no rational use, since the method of Berl[5] of decomposing bisulphate with lime-nitrogen to form ammonia and caustic soda or sodium carbonate was discovered too late to be applicable to war processes.

One way to superconcentrate nitric acid lies in the action of water-binding substances on the dilute nitric acid. Of all the substances proposed for this purpose, such as sulphuric acid, phosphoric acid, arsenic acid, polysulphates, etc., only concentrated sulphuric acid has come to be used technically, since it is available in unlimited amount, the question of raw materials for its manufacture has been solved, the reconcentration of the resulting weak sulphuric acid presents no particular technical difficulty, and the superconcentrating operation itself can be carried out in simple apparatus. In principle, this process depends upon the knowledge that in the ternary system H_2SO_4-HNO_3-H_2O the H_2O vapor pressure is strongly reduced by the H_2SO_4; and the HNO_3, by virtue of its high partial pressure, can easily be driven off in a highly concentrated form. This process is carried out technically by the so-called dry method, consisting in the distillation of a previously prepared nitric acid-sulphuric acid mixture from retorts, either discontinuously,[6] in stages,[7] or continuously by the application of external heat, and perhaps under a vacuum,[8] or the process is carried out in columns, either with external heating or with internal heating from counter-current hot air or gases from an arc fur-

*From *Z. angew. Chem.*, vol. 35, pp. 201-2 and 206-11 (1922).
[1]Ger. Pat. 127,647.
[2]Ger. Pat. 227,377.
[3]Ger. Pat. 63,207.
[4]*Ann. Chem. Pharm.*, vol. 116, p. 204 (1860).
[5]Berl, Defris and Von Boltenstern, *Z. angew. Chem.*, vol. 34, p. 517 (1921).
[6]Erouard, Ger. Pat. 62,714.
[7]Uebel, Ger. Pat. 210,803.
[8]Valentiner and Schwartz, Ger. Pat. 88,321; Raschig, Ger. Pat. 286,975.

nace,[9] in which the abstraction of water is effected by downward trickling sulphuric acid. Or, the process is carried out by the so-called wet method,[10] using steam as the source of heat which is blown into the bottom of a high column. In this case the nitric acid is driven out of a previously prepared mixture or one freshly formed in the tower, by the condensation and combining heat of the steam, while a sulphuric acid of about 70 per cent flows out at the foot of the tower.

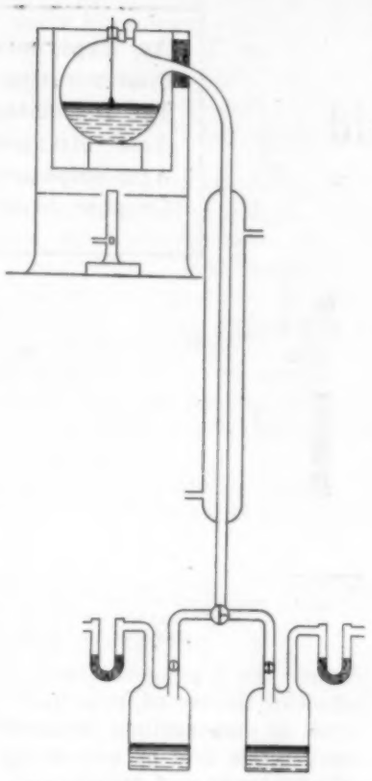


FIG. 2—DISTILLATION APPARATUS USED IN THIS INVESTIGATION

Despite the importance of the problem of superconcentration, only scattered articles appear in the literature, not only on the distillation of nitric acid mixtures but also of nitric acid-sulphuric acid mixtures. Besides the work of Roscoe already mentioned, the boiling point of the mixture with the lowest vapor pressure was determined by Mitscherlich as 120 to 121 deg., by Millon as 125 to 128 deg., and by Smith as 121 deg. C. Galle showed in a recent article[11] a graphical representation of a distillation curve of HNO_3 from a series of experiments by Guido Pauling. In Hausbrand's "Die wirkungsweise der Destillier und Rektifizier-apparate" (1921) is found a table and a graph of the vapors given off by nitric acid-water mixtures, in both cases for acids under 68 per cent. Smith[12] investigated acids above 1.5 specific gravity, and determined the boiling point of a concentrated acid of 1.517 sp.gr. to be 84.4 deg. Creighton and Githens[13] determined the boiling points of nitric acid-water mixtures at various pressures, as did also Pascal and Garnier,[14] who in addition gave a boiling point and condensation point curve for nitric acid.

Saposchnikow[15] investigated the vapor pressure and composition of the vapors of mixtures of nitric acid of 1.52 and 1.48 specific gravity with varying amounts of concentrated sulphuric acid, as well as the specific gravities and conductivities of these mixtures, the influence of water on the vapor pressure at room temperature, and the nitrating action of these acids. The results of the investigation are obscured by an appreciable NO_2 content in the mixed acids.

Pascal and Garnier (above) determined the vapor pressures of nitric acid-sulphuric acid mixtures at various pressures, as well as the boiling points and the vapor compositions. In a further research[16] these investigators reported the specific gravities of these mixtures and in a third[17] the specific heats. C. de la Condamine[18] made a study of the heat balance in the distillation of a nitric acid-sulphuric acid mixture.

Independently of these last-mentioned researches, which were available (partly in short references) to us only very recently, and as a preliminary part of continued researches extending back to 1916, carried out by R. Leiser, the boiling point and distillation curve of nitric acid and the distillation and condensation curves of various mixed acids in the whole region of the Gibbs triangle were determined, in order to arrive at an understanding of the phenomena in the superconcentration of nitric acid.

Distillation of Nitric Acid-Water Mixtures

The purest nitric acid was used in the distillations, prepared from technical nitric acid by distillation, which freed it of various impurities. It was diluted with water to the various concentrations used. In preparing the highest strength of nitric acid a vacuum apparatus was used, shown in Fig. 1. In this it was possible, using five parts of concentrated sulphuric acid to one part of 65 per cent nitric acid and adding some ammonium sulphate (to decompose the NO_2), to obtain at 15 to 20 mm. pressure, in the first portion of the distillate, 100 per cent HNO_3. The receiver had to be strongly cooled, as otherwise the acid, by virtue of its high vapor pressure and low boiling point (33 deg. at 15 to 20 mm. pressure), distilled off to the vacuum pump. By raising the temperature to 45 deg. the remainder of the nitric acid was obtained as 95 to 98 per cent condensate. The acid obtained in this manner, after proper dilution and analysis, was distilled in the apparatus shown in Fig. 2. Particular care was taken that no rectification occurred within the retort-like vessel, by which the results might be changed in an unknown way. The vessel was completely surrounded by an air bath, as well as the connection between the vessel and the condenser; this connection, in addition, being wrapped outside the bath with asbestos as far as its bend. The first acid fractions distilling condensed first in the descending part of the condensing tube. A window in the air bath permitted the boiling point to be noted and its temperature to be read.

The analytical determinations of the highly concentrated nitric acid necessitated particular care from the very beginning, because it is noticeably more hygro-

[9] Swedish Nitric Syndicate, Ger. Pat. 233,031; Norsk Hydro, Ger. Pats. 278,867; 289,745; 292,385, and 300,897.

[10] Pauling, Ger. Pats. 257,809 and 274,165.

[11] *Z. angew. Chem.*, vol. 34, p. 169 (1921).

[12] *Pharm. Centralbl.*, vol. 19, p. 203 (1848).

[13] *J. Frank. Inst.*, vol. 179, pp. 161-9 (1915).

[14] *Compt. rend.*, vol. 165, p. 589 (1917); *Ann. Chim.*, vol. 15, p. 253 (1921); *Chem. & Met. Eng.*, vol. 25, pp. 1103; 1145 (1921).

[15] *Z. phys. Chem.*, vol. 49, p. 697 (1903); vol. 51, p. 609 (1905); vol. 53, p. 225 (1905).

[16] *Bull. Soc. Chim.*, vol. 25, p. 142 (1919).

[17] *Bull. Soc. Chim.*, vol. 27, p. 8 (1920).

[18] *Ind. Chim.*, vol. 5, pp. 153, 187 (1918).

TABLE I.

No.	Per Cent HNO_3 in Original Acid	Per Cent HNO_3 in Residual Acid	Average	Per Cent HNO_3 in Distillate	Boiling Point, Deg. C.
1	12.25	14.64	13.45	0.46	102.5
2	20.15	21.00	20.58	1.28	104.5
3	30.22	33.28	31.75	4.94	108.5
4	37.13	38.85	37.99	9.20	110.4
5	42.73	44.27	43.50	14.86	113.0
6	45.57	49.96	47.77	21.71	115.2
7	52.48	55.44	53.96	33.51	117.5
8	55.37	57.83	56.60	39.37	118.6
9	60.94	62.00	61.47	51.43	120.1
10	62.00	63.27	62.64	54.46	120.4
11	64.95	65.41	65.18	60.62	120.5
12	65.41	65.92	65.67	62.11	120.8
13	67.30	67.56	67.43	65.97	120.8
14	67.84	67.94	67.89	67.84	120.8
15	88.00	68.00	68.00	68.00	121.0

TABLE II.

No.	Per Cent HNO_3 in Original Acid	Compn. of Residue Per Cent HNO_3	Per Cent N_2O_3	Average	Compn. of Distillate Per Cent HNO_3	Per Cent N_2O_3	Boiling Point, Deg. C.
16	69.76	69.11	....	69.44	71.12	....	120.8
17	70.44	69.76	....	70.10	72.56	....	120.7
18	73.51	73.01	....	73.26	79.63	....	119.5
19	79.67	78.18	....	78.92	88.54	0.04	115.4
20	82.57	80.46	....	81.52	92.08	0.07	112.0
21	83.62	80.78	....	82.20	92.87	0.08	111.1
22	85.05	83.67	....	84.36	95.72	0.08	107.0
23	89.33	87.98	....	88.66	97.16	0.09	101.1
24	91.07	88.98	....	90.02	97.34	0.10	99.0
25	91.04	89.43	0.05	90.27	97.68	0.13	98.5
26	94.50	93.24	0.15	93.93	98.52	0.15	91.5
27	97.66	97.03	0.05	97.44	99.07	0.53	86.3
28	99.10	98.75	0.13	99.04	99.24	0.75	84.0
29	99.36	98.88	0.13	99.23	99.12	0.91	83.8

scopic than sulphuric acid and because, as a result of its high vapor pressure, it already begins to evaporate at ordinary temperatures.

With acids of less than 68 per cent HNO_3 the results assembled in Table I were obtained. The NO_2 content of the distillate was in these always below 0.02 per cent, and a yellow coloration of the liquid was not detectable.

With increasing HNO_3 content the boiling point regularly increases, reaching a maximum of 121 deg. with a 68 per cent acid. At this point the original acid, the residual acid and the distillate have the same composition.

The distillation of 68 to 100 per cent HNO_3 mixtures gave the results shown in Table II.

In this, with increasing HNO_3 content, a more and more noticeable decomposition of the acid and distillate sets in, despite a decreasing boiling temperature. The boiling point of a 100 per cent acid, which to begin with was completely free from NO_2, was found to be 83 deg. Nevertheless with continued heating it rose slowly, due to the resulting decomposition and the dilution of the mixture from the water formed therein. The data of Tables I and II are shown in the distillation curve of Fig. 3 and boiling point and condensing point curves of Fig. 4. These curves, which have a completely regular course, do not permit any conclusions with respect to the hydrates of aqueous nitric acid reported upon by

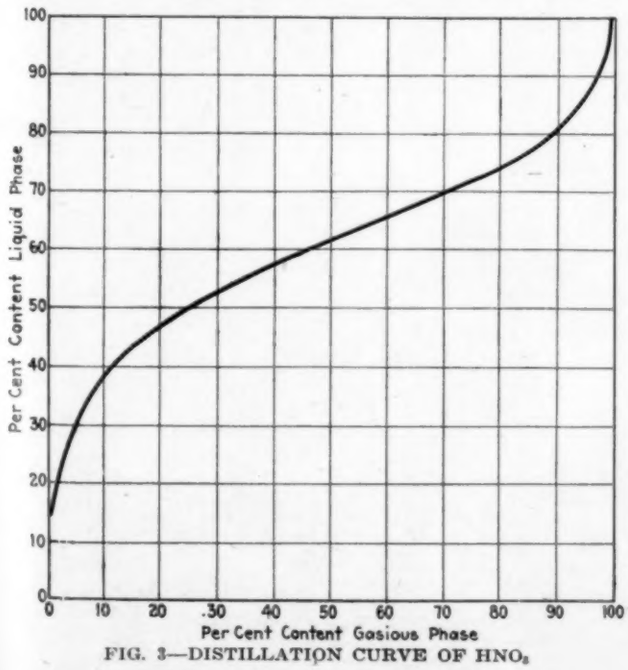


FIG. 3—DISTILLATION CURVE OF HNO_3

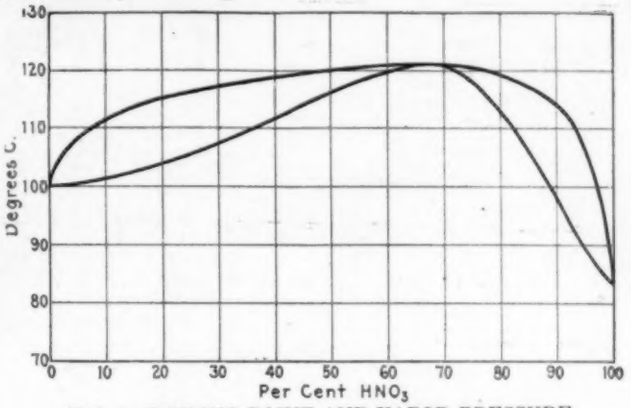


FIG. 4—BOILING POINT AND VAPOR PRESSURE CURVE OF HNO_3

Berthelot[19], Veley and Manley[20], Pickering[21] and Küster & Kreeman[22].

The distillation results at once become quite different if the evolved vapors are dephlegmated by passing them through a rectifying column. If this column is maintained at about 100 deg. with acids weaker than 68 per cent HNO_3, the mixture can be separated into a 65 to 68 per cent acid and an aqueous distillate. With acids above the eutectic point the column should be maintained at 83 deg. C., whereupon 68 per cent acid would be obtained in the residue and 100 per cent acid in the distillate. This principle is exploited in a series of patents[23]. A patent of Berl, taken out in the name of the Deutsche Gasglühlicht-Gesellschaft[24] proposes to convert acids containing less than 68 per cent HNO_3 into an acid of over 68 per cent by distillation with concentrated sulphuric acid, and then to separate this by rectification into an acid of 100 per cent HNO_3 and a 68 per cent residue. Nevertheless rectification is used technically only for pre-concentration, usually for a separation of the original acid into a 55 to 65 per cent residue and a 3 to 5 per cent distillate, since the ideal result of a separation into the eutectic mixture and pure water is not attainable with the apparatus technically available. In order to obtain a residue with 65 per cent HNO_3 or more in practice, it is necessary to accept also a strongly acid distillate. The desired advantage of conversion to a higher strength of acid is hence neutralized by the obtainment of large amounts of strong distillate acid, whose utilization cannot easily be accomplished.

Distillation of Nitric Acid-Sulphuric Acid Mixtures

In the course of this work the phenomena were studied which accompany the distillation of nitric acid-sulphuric acid mixtures, acids being used which contained no, or only a little, nitrogen peroxide. In a further communication the behavior of acids with a high NO_2 content will be reported upon. In these distillations the same apparatus was used that is shown in Fig. 2. The acids were analyzed by the method of Lunge and Berl given in "Chemisch-technischen Untersuchungs Methoden" Vol. 1, p. 878 (1921) and in "Taschenbuch f.d. anorganisch-chemische Grossindustrie," p. 256, using a Berl pipette (*ibid.*, p. 870 and 188).

[19] *Compt. rend.*, vol. 78, p. 769 (1874).
[20] *Proc. Roy. Soc.*, vol. 62, p. 223 (1898); vol. 68, p. 128 (1901); vol. 69, p. 86 (1902).
[21] *J. Chem. Soc.*, vol. 63, p. 436 (1893).
[22] *Z. anorg. Chem.*, vol. 41, p. 1 (1905).
[23] Ver. Chem. Fabriken Mannheim, Ger. Pat. 85,042; Norsk Hydro, Ger. Pat. 336,011.
[24] Ger. Pat. 299,681.

TABLE III—MIXTURE 1

Original acid and composition of residue after each single distillation.	H_2SO_4	21.82	24.48	28.00	32.10	36.80	47.80	61.01
	HNO_3	14.23	15.25	16.03	16.32	15.45	10.76	3.40
	H_2O	63.95	60.27	55.97	51.58	47.75	41.44	35.59
	N_2O_3							
Composition of the individual fractions of distillate from the above acids.	HNO_3	5.81	9.93	14.41	21.97	30.64	37.80	
	N_2O_3	....	....	.....	.....	.....	.....	
	H_2SO_4	....	....	.....	.....	.....	.....	
Per cent of the original HNO_3 in the distillate.		4.4	12.3	21.9	35.5	65.4	91.5	
Strength of total distillate, per cent HNO_3.		5.8	7.8	9.75	12.9	17.1	20.2	
B.p. of mixture, deg. C.		110-112	112-115	115-119	119-121	121-130	130-150	

TABLE IV.A—MIXTURE 2a

H_2SO_4	12.50	14.16	16.51	20.66	26.50
HNO_3	16.31	18.03	20.30	22.85	23.75
H_2O	71.19	67.81	63.19	56.49	49.75
N_2O_3					
HNO_3	3.31	4.52	9.52	19.95	
NO_2	....	....	....	.....	
H_2SO_4	....	....	....	.....	
	2.3	5.8	15.3	31.3	
	3.3	3.9	6.3	9.65	
	107-109	109-111	111-114	114-129	

TABLE IV.B—MIXTURE 2b

Original acid and composition of residue after each single distillation.	H_2SO_4	27.00	29.92	34.47	40.87	49.09	60.72	71.07
	HNO_3	22.97	22.65	21.07	17.60	12.14	4.35	0.43
	H_2O	50.03	47.43	44.46	41.53	38.77	34.93	28.50
	N_2O_3							
Composition of the individual fractions of distillate from the above acids.	HNO_3	25.84	32.91	40.05	44.81	45.23	30.55	
	N_2O_3	.....	.....	.....	.....	.....	.....	
	H_2SO_4	.....	.....	.....	.....	.....	0.05	
Per cent of the original HNO_3 in the distillate.		10.97	28.2	49.5	71.0	91.6	99.4	
Strength of total distillate, per cent HNO_3.		25.84	29.8	33.5	36.1	37.9	36.8	
B.p. of mixture, deg. C.		119-121	121-122	122-126	126-133	133-147	147-172	

TABLE V.—MIXTURE 3

H_2SO_4	2.03	2.91	4.23
HNO_3	5.93	7.81	10.47
H_2O	92.04	89.28	85.30
N_2O_3			
HNO_3	1.63	1.95	
N_2O_3	....	....	
H_2SO_4	....	....	
	8.1	15.2	
	1.63	1.73	
	102	102-103	

TABLE VI.—MIXTURE 4

Original acid and composition of residue after each single distillation.	H_2SO_4	24.31	28.35	33.50	37.83	47.63	60.03
	HNO_3	26.18	25.43	23.52	21.08	13.98	5.25
	H_2O	49.51	46.22	42.98	41.09	38.39	34.72
	N_2O_3						
Composition of the individual fractions of distillate from the above acids.	HNO_3	30.61	36.67	40.04	48.44	49.05	
	N_2O_3	.....	.....	.....	.....	.....	
	H_2SO_4	.....	.....	.....	.....	.....	
Per cent of the original HNO_3 in the distillate.		16.7	34.9	48.3	72.9	91.9	
Strength of the total distillate, per cent HNO_3.		30.6	33.2	35.4	38.9	40.4	
B.p. of the mixture, deg. C.		118.5-120	120-122.5	122.5-124.5	124.5-132	132-147	

TABLE VII.—MIXTURE 5

H_2SO_4	10.30	12.42	15.47	21.40	29.50
HNO_3	29.68	32.79	35.38	35.15	30.83
H_2O	60.02	54.79	49.15	43.45	39.67
N_2O_3					
HNO_3	14.61	22.38	35.68	46.91	
N_2O_3	.....	.....	.....	.....	
H_2SO_4	.....	.....	.....	.....	
	8.35	20.5	42.9	63.6	
	14.6	18.3	24.6	29.0	
	112-114.5	114.5-118	118-120.5	120.5-133.5	

TABLE VIII.—MIXTURE 6

Original acid and composition of residue after each single distillation.	H_2SO_4	9.87	10.58	12.41	13.85	17.15	23.14
	HNO_3	44.82	45.35	46.00	45.84	44.44	39.80
	H_2O	45.31	44.07	41.59	40.31	38.41	37.06
	N_2O_3						
Composition of the individual fraction of distillate from the above acids.	HNO_3	37.17	42.47	47.30	51.41	56.74	
	N_2O_3	.....	.....	.....	.....	.....	
	H_2SO_4	.....	.....	.....	.....	.....	
Per cent of the original HNO_3 in the distillate.		5.6	18.4	27.2	42.9	62.2	
Strength of the total distillate, per cent HNO_3.		37.2	40.1	42.4	45.6	48.6	
B.p. of the mixture, deg. C.		119	119-120.5	120.5	120.5-121.5	121.5-123.5	

TABLE IX.—MIXTURE 7

H_2SO_4	4.00	5.10	6.11	7.45	9.13
HNO_3	61.34	61.15	60.42	59.30	57.60
H_2O	34.66	33.75	33.47	33.25	33.27
N_2O_3					
HNO_3	62.00	64.62	65.48	66.92	
N_2O_3	.....	.....	.....	.....	
H_2SO_4	.....	.....	.....	.....	
	21.7	35.6	48.2	58.8	
	62.0	63.2	63.7	64.2	
	120.6	120.8	121	121-122	

TABLE X.—MIXTURE 8

Original acid and composition of residue after each single distillation.	H_2SO_4	47.95	50.90	55.22	63.19	69.83
	HNO_3	17.36	14.51	10.61	4.12	0.86
	H_2O	34.66	34.57	34.15	32.68	29.31
	N_2O_3	0.03	0.02	0.02	0.01	.....
Composition of the individual fractions of distillate from the above acids.	HNO_3	63.81	60.99	56.57	40.59	
	N_2O_3	.....	.....	.....	.....	
	H_2SO_4	.....	.....	.....	0.19	
Per cent of the original HNO_3 in the distillate.		21.2	46.9	82.0	96.6	
Strength of the total distillate, per cent HNO_3.		63.7	61.8	59.1	53.6	
B.p. of the mixture, deg. C.		131.5-134	134-137.5	137.5-150	150-169	

TABLE XI.—MIXTURE 9

Original acid and composition of residue after each single distillation.	H_2SO_4	9.03	10.21	11.58	12.82	16.60	20.47	26.94
	HNO_3	71.06	68.45	65.45	63.13	56.87	51.09	42.85
	H_2O	19.91	21.34	22.97	24.05	26.53	28.44	30.21
	N_2O_3							
Composition of the individual fractions of diatillate from the above acids.	HNO_3	91.41	90.20	87.29	84.48	81.09	77.59	
	N_2O_3	.....	0.06	0.09	0.09	0.07	0.11	
	H_2SO_4	.....	.....	.....	.....	.....	.....	
Per cent of the original HNO_3 in the distillate.		17.4	28.2	37.3	56.6	68.4	79.8	
Strength of the total distillate, per cent HNO_3.		91.4	90.9	89.8	88.1	86.9	85.4	
B.p. of the mixture, deg. C.		114-115.5	115.5-117.7	117.7-118.5	118.5-119	119-121	121-122	

TABLE XII.—MIXTURE 10

H_2SO_4	25.41	28.65	35.67	49.62	67.25
HNO_3	59.15	54.40	44.40	25.80	5.17
H_2O	15.44	16.95	19.93	24.58	27.58
N_2O_3					
HNO_3	96.16	94.92	91.96	82.91	
N_2O_3	0.19	0.21	0.25	0.29	
H_2SO_4	.....	.....	.....	.....	
	18.5	46.5	77.6	96.6	
	96.2	95.7	94.2	91.9	
	109-110	110-114.5	114.5-122.5	122.5-160	

TABLE XIII.—MIXTURE 11

Original acid and composition of residue after each single distillation.	H_2SO_4	65.20	70.81	75.75	78.77	81.63
	HNO_3	17.50	10.61	4.70	1.50	0.09
	H_2O	17.31	18.55	19.51	19.68	18.28
	N_2O_3		0.03	0.04	0.05	.....
Composition of the individual fractions of distillate from the above acids.	HNO_3	96.20	93.02	82.77	48.95	
	N_2O_3	0.91	1.14	0.99	.....	
	H_2SO_4	.....	.....	0.21	0.37	
Per cent of the original HNO_3 in the distillate.		44.1	76.9	93.0	99.7	
Strength of the total distillate, per cent HNO_3.		97.4	96.2	94.1	86.7	
B.p. of the mixture, deg. C.		120-136	136-160	160-178	178-216	

TABLE XIV.—MIXTURE 12

H_2SO_4	64.11	69.32	72.41	
HNO_3	20.92	14.71	11.02	
H_2O	14.89	15.90	16.47	
N_2O_3	0.08	0.07	0.10	
HNO_3	96.73	96.23		
N_2O_3	0.55	0.70		
H_2SO_4	.....	.....		
	35.0	53.5		
	97.6	97.4		
	124.5	124.5-140		

TABLE XV.—MIXTURE 13

Original acid and composition of residue after each single distillation.	H_2SO_4	71.87	77.03	79.35	81.71	83.54
	HNO_3	12.98	6.95	4.20	1.61	0.25
	H_2O	15.14	15.96	16.34	16.64	16.18
	N_2O_3	0.01	0.06	0.11	0.04	0.03
Composition of the individual fractions of distillate from the above acids.	HNO_3	96.25	94.13	89.42	70.77	
	N_2O_3	1.27	1.72	2.31	0.14	
	H_2SO_4	.....	.....	0.21	0.43	
Per cent of the original HNO_3 in the distillate.		50.1	62.6	89.1	98.4	
Strength of the total distillate, per cent HNO_3.		98.3	97.7	97.0	91.6	
B.p. of the mixture, deg. C.		121-155	155-168	168-190	190-220	

TABLE XVI.—MIXTURE 14

H_2SO_4	22.25	24.94	28.05	39.00	54.41	81.15
HNO_3	75.35	72.28	68.74	56.46	39.30	9.67
H_2O	2.35	2.66	3.06	4.38	6.12	8.94
N_2O_3	0.06	0.12	0.16	0.16	0.17	0.24
HNO_3	99.10	99.14	98.88	98.94	96.82	
N_2O_3	0.93	0.68	1.01	1.06	2.84	
H_2SO_4	.....	.....	.....	.....	.....	
	14.4	27.8	57.5	78.8	96.6	
	100.6	100.4	100.4	100.3	100.2	
	88.5-90	90-92	92-95	95-100.5	100.5-131	

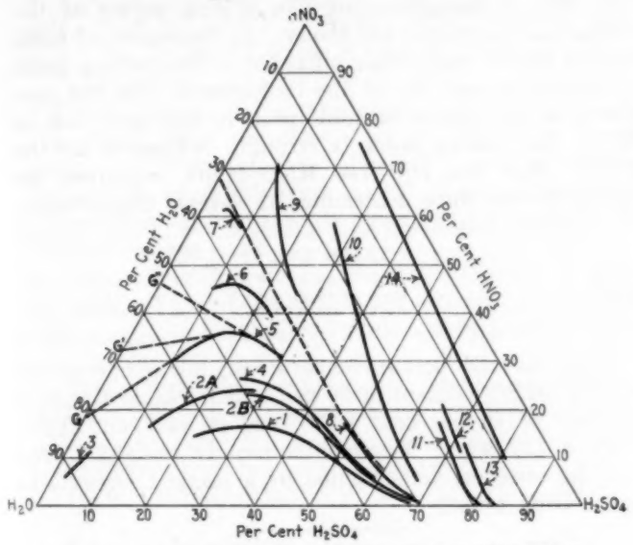


FIG. 5—DISTILLATION CURVES OF H_2O-HNO_3-H_2SO_4 MIXTURES

During the course of the distillation samples of acid were removed from the distilling flask with an arrangement modeled on the Lunge acid pipette, while simultaneously the three-way cock was turned to the second receiver. Two distillations in the same series were always made.

First, a series of experiments was carried out on acids with a high water content. The results are shown in Tables III to X, and graphically in Fig. 5.

At the start of the distillation of acid mixtures with more than 32 per cent H_2O a strongly aqueous distillate first comes over, whose HNO_3 content is lower than that of the acid in the still. The vapor pressure of H_2O in this region is strongly manifest and is only slightly influenced by the presence of H_2SO_4. A water-binding action of the H_2SO_4 does not become evident; which results in the fact that the H_2O content of the residue regularly decreases because of the distilling over of a dilute but increasingly stronger nitric acid. The distillation curves of Fig. 5 show at the start an inflection which lies at a point where the HNO_3 contents of the distillate and the residue are the same. Above this point, moreover, there comes over a distillate increasingly stronger in HNO_3, until finally a new point of inflection is reached in the curve, beyond which the HNO_3 content of the distillate regularly and very rapidly decreases. In the meanwhile the boiling point of the acid mixture rises so high (165 deg. and higher) that small amounts of H_2SO_4 come over. It is not possible, therefore, to drive off the last traces of HNO_3 free from H_2SO_4.

The phenomena with acid mixtures containing less than 32 per cent are different, as may be seen from Tables XI to XVI.

In this region (see Fig. 5) the distillation curves throughout most of their length approximate straight lines which do not vary very much from the straight lines expressing H_2SO_4 : H_2O ratios in the various mixtures. At the very beginning of the distillation, owing to the strong water-binding action of the H_2SO_4, a strong distillate comes over, which, however, slowly decreases in strength, until, after most of the HNO_3 has been driven out, the curve breaks sharply, and thereafter a distillate more and more rich in water comes over. Through the rising boiling point of the mixture the water-binding power of the H_2SO_4 is so far lowered —i.e., the vapor pressure of the H_2O becomes so great— that greater amounts of H_2O go over with the distillate and strongly dilute it. H_2SO_4, also, distills over in the case of such H_2SO_4-rich and HNO_3-poor mixtures.

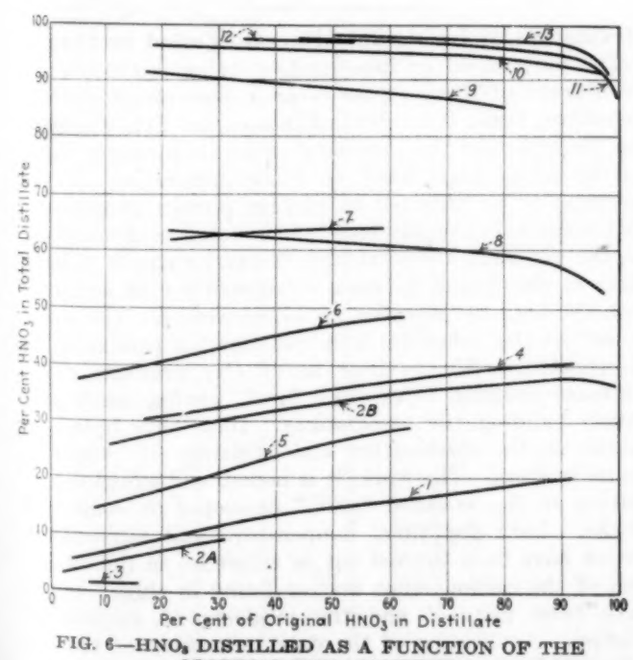


FIG. 6—HNO_3 DISTILLED AS A FUNCTION OF THE ORIGINAL HNO_3 CONTENT

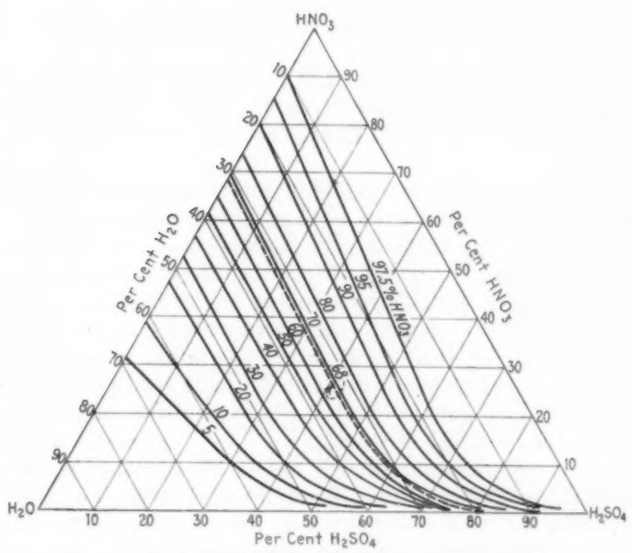


FIG. 7—COMPOSITION OF VAPORS FROM BOILING H_2O-H_2SO_4-HNO_3 SOLUTIONS

In Fig. 6 the HNO_3 content of the total fraction is graphically shown as a function of the percentage, in the total fraction, of the HNO_3 originally present in the mixture. The values are calculated by addition of the single fractions. It may be seen that in the case of the acids rich in H_2O (from 100 to 32 per cent H_2O content) the HNO_3 content of the distillate continually increases and only when the highly aqueous end fractions come over does it decrease (curve 2B). However, in this case no acid stronger than 68 per cent is obtained. In the case of the mixtures with less than 32 per cent H_2O, the strength of the distillate first slowly decreases, but when

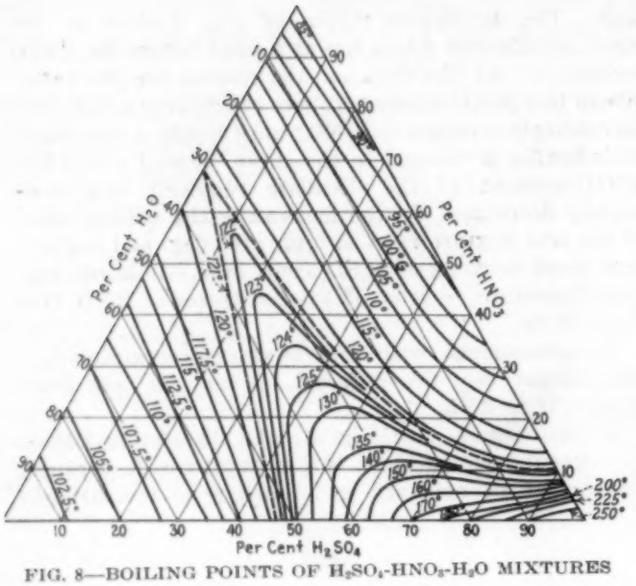


FIG. 8—BOILING POINTS OF H_2SO_4-HNO_3-H_2O MIXTURES

about 90 per cent of the HNO_3 originally present has come over, decreases more rapidly when the residual HNO_3 distills over, as is clearly evident from curves 11 and 13.

From the distillates obtained from the different mixed acids curves of mixtures evolving like strength distillates can be constructed in triangular co-ordinates, as shown in Fig. 7. Tangents to the distillation curves (Fig. 5, curve 5) produced to cut the H_2O-HNO_3 axis enable the HNO_3 content to be read directly as the distance H_2O-G; H_2O-G' or H_2O-G'', assuming, of course, that the distillate contains only H_2O and HNO_3, but no H_2SO_4. H_2SO_4 appears in the distillate from mixtures with a very low HNO_3 content.

As is evident from Fig. 7, the HNO_3 content of the distillate is almost a function of the H_2O content of the mixture, but this does not hold for mixtures low in HNO_3. Therefore, it is not practicable to superconcentrate strongly aqueous nitric acid solutions with concentrated sulphuric acid, because a relatively large amount of sulphuric acid would have to be used to reduce the H_2O content of the mixture as much as is necessary to obtain a mixture which would yield a high strength distillate. In that case a relatively great amount of dilute sulphuric acid would result which would require a greater heat consumption and heavier repair costs than if dilute nitric acid were preconcentrated by rectification, this preconcentrated acid were superconcentrated with a correspondingly smaller amount of sulphuric acid, and the resulting sulphuric acid were itself highly concentrated.

Thus, for example, to concentrate 100 parts 100 per cent HNO_3 from 35 per cent HNO_3 to 92.5 per cent HNO_3 would require 670 parts 96 per cent sulphuric acid. If the nitric acid were first preconcentrated from 35 per cent HNO_3 to 65 per cent HNO_3 the same 100 parts HNO_3 (excluding rectification losses) in the form of 154 parts 65 per cent acid would require only 147 parts 96 per cent sulphuric acid to be concentrated to 92.5 per cent.

In the first case there would have to be removed from the resulting dilute sulphuric acid, in order to reconcentrate it, 178 parts H_2O, while in the second case only 46 parts H_2O—namely, scarcely two-fifths—for the same amount of HNO_3 in the strong distillate.

In Fig. 8 the curves of like boiling points of the various acid mixtures are shown. In the region of acids rich in H_2O no particular influence on the boiling point is exerted by any one of the components. On the contrary, in the region of acids poor in H_2O and rich in HNO_3, the boiling point is strongly influenced by the HNO_3. For the H_2O-free HNO_3-H_2SO_4 mixtures the boiling points were determined in several experiments.

TABLE XVII.

H_2SO_4	33.3	60.0	75.0	80.0	86.0	94.0
HNO_3	66.7	40.0	25.0	20.0	14.0	6.0
Deg. C.	84.5	93.0	103.5	108.0	115.0	185.0

Such mixtures boil at comparatively low temperatures until an H_2SO_4 content of 90 per cent is reached (e.g., a mixture of 10 per cent HNO_3 and 90 per cent H_2SO_4 boils at 122 deg.). Further increase in the H_2SO_4 content is, however, accompanied by a marked increase in the boiling point.

Effects of Breathing Carbon Dioxide

Experiments on the effects of breathing carbon dioxide have been conducted at the Pittsburgh, Pa., station of the United States Bureau of Mines under the direction of Dr. R. R. Sayers, chief surgeon of the bureau, and A. C. Fieldner, supervising chemist. About 2 per cent of carbon dioxide in oxygen produced a slight increase in lung ventilation but no subjective symptoms; 5 per cent in oxygen caused an increase in lung ventilation of about 100 per cent, but no other signs or symptoms; 7.2 per cent produced about 200 per cent increase in lung ventilation, and moderate perspiration and a slight fullness in the head were experienced after breathing the mixture for 10 minutes; 9 to 10 per cent produced about 300 per cent increase in lung ventilation, and the subject complained of frontal headache and was dizzy and perspiring at the end of 10 minutes. About 9 per cent of carbon dioxide in oxygen was breathed by some of the subjects for as long as 45 minutes, but the breathing was very laborious, and dizziness, headache and perspiration were marked. In fact, to have done any work while breathing this mixture would have been extremely difficult.

Oxidation of Incidental Minerals Found in Clays

The purpose of an investigation being conducted by the Bureau of Mines at the ceramic experiment station, Columbus, Ohio, is to obtain fundamental data concerning the action of the incidental minerals found in clays during firing and, later, to make application of the information so obtained to explain certain phenomena that occur with the clay body. It is hoped to throw light on the physical, chemical and thermal changes taking place in clay bodies between a temperature of 400 deg. and 800 deg., the so-called oxidation period. The work is part of the industrial kiln investigation conducted in co-operation with the four heavy clay products associations—common brick, face brick, paving brick and hollow building tile associations. Data have been obtained on the dissociation and oxidation of sulphides found in clays. The work, it is hoped, will afford information on the so-called "scum" developed on some red bricks. Data for time, temperature and atmosphere curves have been worked out in reference to the oxidation of the carbonaceous matter found in clays. Clays have been distilled and the products of distillation studied. Application of the data to a study of the so-called "bloating" of clay products is being made.

The B.t.u. Chart

BY CHARLES J. LOHMAN, JR.
University of Cincinnati

THE commercial analysis of coal concerns itself chiefly with the caloric value, or British thermal units, per pound of coal. The B.t.u. determination is important, therefore, first, as a basis for knowing the actual heat value of the coal; second, as a means of comparing various coals.

The determination is usually made on a partly dried sample, and the results are reported on the actual basis and the dry basis—the dry basis being the basis of comparison.

The calculations required are greatly simplified by using the same weight of sample for each determination, or by referring results to the 1-gram basis. The calculations then reduce to these forms:

B.t.u. (actual basis) $= (ET - H)\ (1 - M')$

$$\text{B.t.u. (dry basis)} = \frac{ET - H}{1 - M''}$$

E = Calorimeter factor

T = Temperature rise corrected for radiation and thermometer correction

H = Correction for fuse wire, sulphur and nitrogen

M' = Gross moisture, or loss in weight due to first drying.

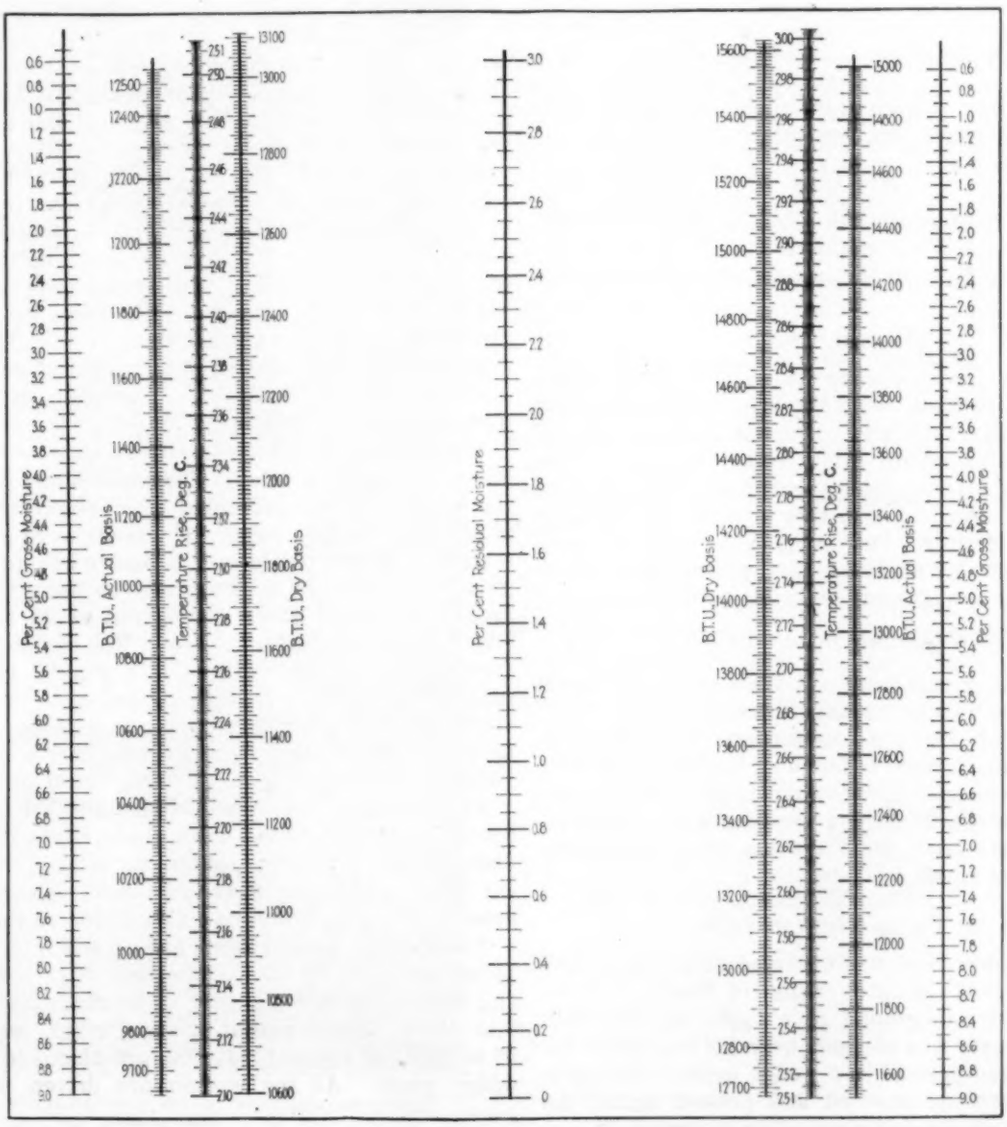
M'' = Residual moisture, or loss in weight due to second drying.

H is usually considered constant in the ordinary commercial analysis. E is practically constant, as there is very little corrosion, even in the nickel-lined bombs.

Where a large number of determinations are made, quite a little time is required to make the necessary calculations, as the numbers involved are too large to be handled with the ordinary 12-in. slide rule. The accompanying chart was therefore devised, to make the calculations quickly, as well as to eliminate the chance for errors.

The middle axis is scaled off in log $(ET - H)$, and is graduated in the equivalent temperature rise. The chart is constructed for the calorimeter factor, 5070, a correction of 53 B.t.u. being made for fuse wire, sulphur and nitrogen.

To use the chart, lay a straight edge across the chart so that it intersects the "temperature rise" and one of the "per cent moisture" axes at the values determined. Where the straight edge intersects the intervening axis, read the result in B.t.u. The chart is accurate to ±5 B.t.u., which is all the accuracy that is required.



Native Oil Production In Western China

By H. K. Richardson

Extraction Processes, Uses and Economic Importance of Native Chinese Vegetable Oil Industry—Nut Oils, Seed Oils and Soy Bean Sauce Manufacture—United States Takes the Largest Amount of the Exported Product

THE PRODUCTION of vegetable oils is one of the most important native industries in the Province of Szechuen, Western China. Almost any kind of seed or nut that will yield oil is made to give up that oil for some purpose or other. Only those oils that are obtainable in the native shops are listed below. The order followed under each heading indicates approximately the local economic importance of the oil.

Vegetable Seed Oils

T'sai Yu or Ching Yu, vegetable oil, is obtained from the seed of a cabbage grown for its seed only. This oil is erroneously called rape by foreigners. It is the common cooking oil of the common people.

Hsiang Yu, fragrant oil, from sesamum seed.

Peanut oil.

Cottonseed oil.

Tea oil, from the seeds of the tea flower.

Castor oil.

Soy bean sauce, a high-grade cooking oil made from soy beans and wheat, by fermentation.

Nut Oils

T'ung Yu or chinawood oil. This is the most important export oil of Western China.

Walnut oil made from the kernels of the english walnut tree.

Mineral Oils

It has been reported many times that crude petroleum is obtained along with the brine in the deep salt well districts of Tzuliutsing. During a stay of several days we failed to see any evidences of crude oil. Close questioning of natives and resident foreigners failed to reveal anyone who had seen this kind of oil. Oil may exist in this territory, but its quantity must be small when it has not materialized in the drilling of about 20,000 wells to a maximum depth of 3,400 ft.

Vegetable Seed Oils

The methods of obtaining oils from seeds are three: Pressing, water extraction and fermentation.

Since the *T'sai Yu* is the most common oil, the technique of its manufacture is the most thoroughly worked out. The process used for the extraction of this oil will be described in detail. Where the details of production of an oil differs from the *T'sai Yu*, these differences only will be described.

T'sai Yu, or Vegetable Oil

The process described was observed in a custom mill outside the city of Chengtu, capital of Szechuen Province. The seed was ground to a paste between millstones. The paste was steamed over boiling water for an hour and then pressed in a wedge press. The press cake was broken up, steamed and pressed again, the residue being sold for fertilizer. The extracted oil was

FIG. 1—GENERAL VIEW OF WATER GATES OF CUSTOM MILL OUTSIDE CHENGTU

settled, filtered through coarse grass paper and the clear oil marketed. From 600 lb. of seed about 120 lb. of oil was obtained from the first pressing and 80 lb. from the second. Thus the percentage of oil recovered to seed used was 33⅓ per cent. Consular reports from other parts of China show recoveries ranging from 34 to 45 per cent with 7 to 8 per cent oil remaining in the cake. Hosie[1], apparently describing this same mill, gave the yield as 32 per cent. His figures were obtained 15 years before ours, showing that there had been no change in the process in that time.

The apparatus in this mill is typical of that in common use. While crude in construction, it serves its purpose well and cheaply.

The grinder consisted of two millstones about 4 ft. in diameter, and 9 in. thick. The upper stone rested upon the lower and was prevented from revolving by ropes attached to upright posts. The seeds were poured into a wooden hopper placed over a square hole in the upper grindstone and fed automatically to the grinding surface. The lower stone was driven at 28 r.p.m. by a water wheel attached to its base. The irrigation stream furnished the power. Fig. 1 is a general view of the mill. Fig. 2 is a photograph of one of the four grindstones at work. Fig. 3 gives a clearer idea of the setup of the machinery. The grinder had a capacity of 1,680 catties, or 2,240 lb., of "rape" seed per 24 hours.

The steamer is a large wooden tub with a woven bamboo sieve bottom set down over an iron pan 4 ft. in diameter and 1 ft. deep, containing boiling water. The vat holds a half ton of crushed seed, enough for two press loads. Fig. 4 gives a cross-section of the steamer.

The steamed ground seeds are packed into iron rings 1¼ in. high and 18 in. in diameter. Rice straw on top and bottom permits the seed to be made up in plinths 3 in. thick. Twenty-eight of these rings, each holding 15 to 20 lb. of crushed material, are placed in a wooden wedge press. As the wedges are driven in, the oil

[1]Hosie, "Report on the Province of Szechuen," London, 1904.

trickles out into a vat under the press. The final pressure is obtained by iron wedges driven home with a battering ram. The press is permitted to stand over night under pressure. Filling a press and bringing up to pressure take a whole day. The first press cake is taken out, broken up and re-pressed after steaming. The oil from the first pressing is considered the better, but it is rarely kept separate from the second run. The construction of this press can be seen from Fig. 5, which is a photograph of such a press taken when operating on peanut oil. The total length of press is 16 ft.; the pressing space is 6 to 7 ft.

Some general information regarding the mill is of interest. The mill operates on a percentage basis, receiving three catties out of each 150 catties of oil expressed. This was paid to the mill owner as rental of the machinery and water power. The seed owner furnished labor and fuel for the steamer as well as all seed. The labor cost of grinding was 40 cash per 240 catties, or an equivalent of 8 cents per ton of seed.

The complete grinding wheel cost 12 taels, or $9 gold. The stones last 3 years. The water turbine blades and run are replaced yearly at a cost of about $1.50. The complete press cost installed about $25. Two presses expressed about 40,000 catties (53,333 lb.) of oil a year.

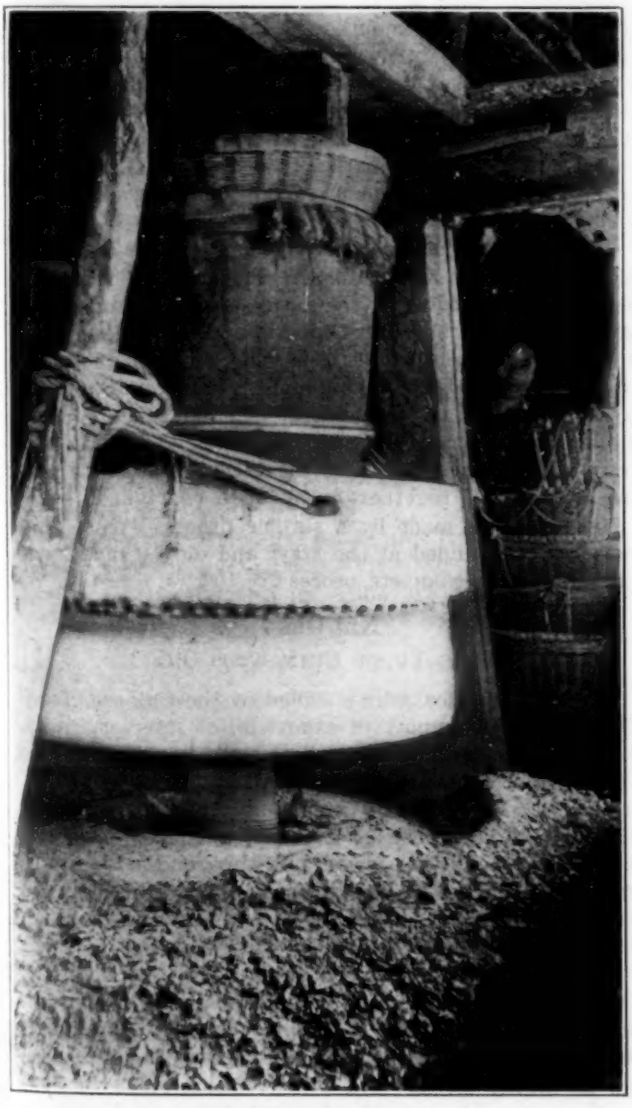


FIG. 2—WATER-POWER GRINDSTONES GRINDING RAPESEED

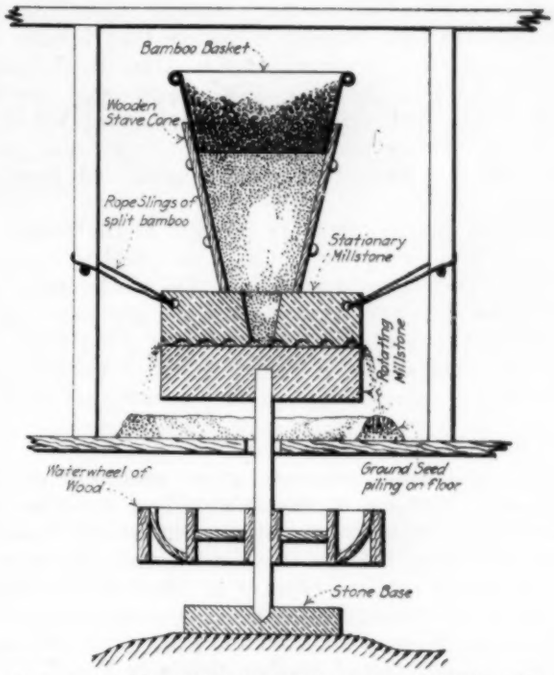


FIG. 3—CROSS-SECTION OF WATER WHEEL AND MILLSTONES

This *T'sai Yu* is the most useful oil in the Chinese economy. It is the principal cooking oil of the common people. The vegetables that accompany the rice diet are all fried in this oil. Until the advent of American kerosene it was the lighting oil of the province. Even today a rush wick dipping in this oil floating on water in a glass tumbler is the usual lamp in the wayside inns. In the cities there are few who can afford the foreign oil for lighting. For this reason the cotton-wick three-spouted copper-pewter lamps and the rush-wick earthen lamp still use *T'sai Yu* as the illuminant in the majority of homes.

This oil is erroneously called "rapeseed" by foreigners. Wilson[2] says that there is no true rape in Szechuen. He designates *Brassica juncea* and *Brassica campestris* as the members of the cabbage family that yield this seed. He estimated from his 11 years' experience that 75 per cent of all the oil produced in Szechuen came from these two plants.

Hsiang Yu, or Sesamum Seed Oil

This oil, called "fragrant" by the natives, is extracted by water, not pressed, from the seeds of *Sesamum indicum*. The white seeds are washed in cold water and

[2]Wilson, "A Naturalist in Western China," Doubleday, Page & Co., 1913.

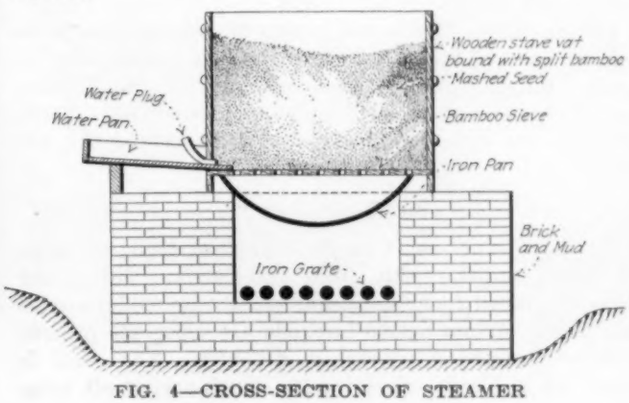


FIG. 4—CROSS-SECTION OF STEAMER

air-dried, after which they are roasted in an iron pan until they are light brown. They are then ground between millstones. Boiling water is added to the paste until no more is absorbed. The liquid mass is then lightly tapped with a weighted gourd, causing the oil to rise to the surface and the refuse to sink. The oil is poured off and the refuse removed and sold for feed for pigs.

The yield of oil is 40 to 44 per cent of the weight of the seed. In other parts of China the yield is reported to range from 50 to 57 per cent. The white-seeded oil is the most expensive edible oil in the province and is frequently adulterated with the cheaper *T'sai Yu*.

As far as the author is aware, this oil is the only one recovered by water extraction on a commercial scale.

Peanut Oil

Peanuts, *Arachis hypogœa*, grow profusely on the sandy river bottoms of Szechuen. Two varieties are grown. One, the native variety, resembles our Spanish peanut; the other is large, like the Virginia peanut, and was introduced into the country by the French priests. The oil is usually expressed from the smaller variety.

The whole peanut is roasted and ground up, shell and all, in a trough type of crusher shown in Fig. 6. The ground mass is then treated the same as we have described for *T'sai Yu*. The yield is about 16 per cent of the unshelled weight of nuts. The 40 to 43 per cent yields reported in consular reports from other parts of China must refer to the shelled nut.

Cottonseed Oil

Small amounts of cotton seed, *Gossypium herbaceum*, are pressed for their oil. The oil is looked upon as inferior and is used as an adulterant in the more highly esteemed oils.

Tea Oil

The seeds of the wild tea plant, *Camellia oleifera*, yield when pressed an oil whose principal use is for my Chinese lady's hair oil. The refuse cake has the reputation of taking out stains when used in wash water and of destroying the earth worms that attack rice plants. In the latter case the cake is mixed in the fertilizer for the paddies.

Castor Oil

The castor oil plant, *Ricinis communis*, grows to be a tree in the warm, humid climate of Szechuen. We had a plant in our yard that was 20 ft. high and 3 in. in diameter. The primary use for this oil is to moisten the colors used as stamp pads for the red Chinese seals or "Chops" as pidgin English has it. The yield is about 38 per cent of oil.

Various kinds of flax are grown in considerable quantities in the province. Fine hemp and ramie fiber is made. Except in case of the wild flax of the Tibetan frontier, the seed is used only as a birdseed. Probably the prevalence of wood oil has prevented the use of this seed for linseed oil.

Soy Bean Sauce

Soy bean sauce must be distinguished from soy bean oil, which comes mostly from Manchuria. This latter oil is expressed from soy beans mostly by modern pressure mills. When native methods are used, the process outlined for the *T'sai Yu* is followed. The yield is about 13 per cent of oil and a much-prized oil cake. Only a negligible quantity of this expressed oil is made in Szechuen. On the other hand, only 10 per cent of the beans raised in Manchuria is made into soy sauce, the remainder being expressed or shipped out whole.

In western China the soy bean, *Glycine hispida*, is extensively cultivated, but is used as a vegetable, for bean curd and for sauce. The soy bean sauce is the dark red sauce seen on the tables of Chinese restaurants in this country.

The process of obtaining soy bean sauce is one of fermentation and is long and complicated. Accurate information on this process is difficult to obtain. What follows has been pieced together from several sources. There are two kinds of soy: the red, or long process, and the yellow, or short process. The red soy is considered the better and is the only one found on the tables of good restaurants in China.

The process of manufacture extends over a period of approximately one year. The soy beans are first soaked over night in water and steamed for 5 hours. After thoroughly cooling, they are mixed with wheat flour and permitted to stand in a bamboo basket until a yellow mold appears—generally about 7 days. The mass is mixed with equal parts of water and salt in an earthen jar, covered and placed in the sun for 3 months, being stirred every day. By this time all the water has evaporated. For several months the jar is covered at night and stands open during the day. Finally, the black pickle is mixed with boiling water and thoroughly stirred. A bamboo basket sieve is placed in the top of the jar, the soy sauce passes through the sieve and is bailed out for 2 or 3 days. This is boiled with white sugar, seasoned with peppers and anise seed and is ready for use.

Twenty-eight pounds of soy beans yields 70 lb. of the soy sauce, according to Hosie'. The increase is due to the materials added in the process of making. This sauce is the foundation of all high-class Chinese cooking. It costs about 20 per cent more than the common "rape" oil. Very little of this material made in Szechuen is exported, for the large local demand takes care of the supply. A plant making this material looks like a drain pipe storage yard, for the big earthernware pots are set up close together, in an open courtyard.

Yellow soy is made by a similar process except that more water is added at the start and only 3 months is allowed for the complete process.

Nut Oils

Tung Yu, or Chinawood Oil

Chinawood oil, or as it is called by the Chinese, *Tung Yu*, is the most important export oil of interior China. Probably three-quarters of all the oil that reaches the United States comes originally from the Province of Szechuen. Most of the producing centers are at the eastern end of the post road from Wanhsien to Chengtu. It was our privilege to travel over this road a few years ago. The following description of how the Chinese obtain this oil is a composite of observations made on this trip and data picked up in nearby sections:

Chinawood oil is the product of a nut borne by the *Aleuritis fordii*. This tree thrives mostly on rocky soil, growing where nothing else will grow. It is found at about the 2,500-ft. elevation, although we have seen a few at higher levels. The fruits, which ripen in September, resemble smooth chestnut burrs and contain three to five nuts the size of good eating chestnuts.

To obtain the oil, the fruits are gathered just before ripening and stacked in piles until fermentation destroys the covering. Then the nuts are removed, dried and ground—shells and all—in a mill shown in Fig. 6. The ground mass is slightly roasted, then steamed and expressed in a wedge press like the one shown in Fig. 5. The yield of oil is approximately 40 per cent.

The roasting is done in shallow iron pans, 3x8 ft., set in brickwork over a coal fire. Usually a 2-in. layer of the ground seed is heated. The grinding is accomplished in a stone trough grinder such as is illustrated in Fig. 6. This type of grinder is used for all seeds with a hard coating as well as for rice hulling. They are operated by animal power as well as by man power. The construction is more clearly shown in Fig. 7, which is a top view of a small unit belonging to a peasant farmer.

The expressed oil is collected by the local merchants from the mills and sent over the post road to Wanhsien, from where it is transshipped by cargo junk to Hankow.

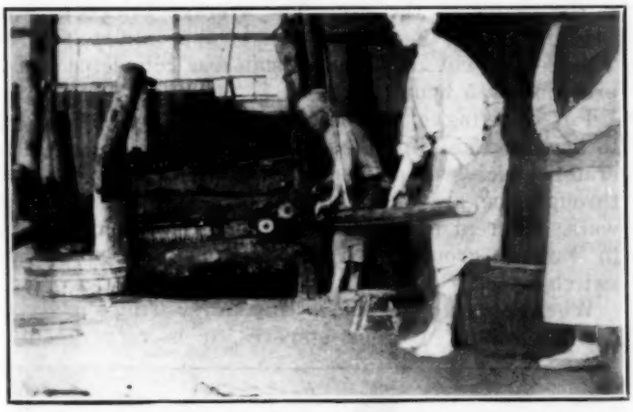


FIG. 5—WEDGE OIL PRESS SHOWING BATTERING RAM USED TO FORCE UP WEDGES

The method of packing is usually in bamboo wickerware baskets lined with paper. When oil is first poured into the paper lined basket the paper is wet, but no further oil is lost, because the oil does not filter through the paper used. A bottle of this kind holding 150 lb. of oil, suspended from a pole between two men, will be carried at the rate of 30 miles per day.[3]

The uses of the wood oil in the United States as a constituent of quick-drying cheap gum varnishes are well known. Its uses in China are manifold and less known. A few of these uses will be enumerated.

Native Uses for Chinawood Oil

All Chinese boats of the native pattern are given a thorough oiling with the wood oil. No other paint or preservative is used or needed. The putty used to calk the seams of these boats is made from a mixture of whiting, bamboo shavings and wood oil. It dries to a very hard material much superior to linseed oil putty. The oil when used for this purpose is boiled for an hour. This is the *pei yu* of the Chinese.

The first coat in painting a house or cheap furniture in China is a mixture of glue and pigment. This coat dries to a matt surface. The second coat is pure chinawood oil. The result is a fine glossy finish the color of the underlying dye or pigment. The oil used for this purpose is specially prepared. The crude oil is boiled

[3]The method of handling and financing this trade after it reaches Hankow is fully explained in *Daily Commerce Reports* for Feb. 9, 1921, p. 812.

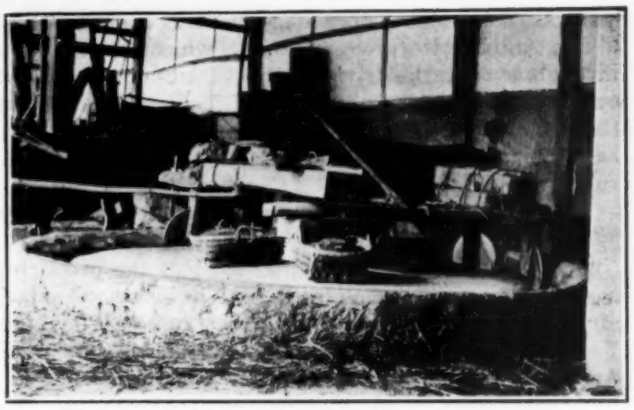


FIG. 6—CIRCULAR TROUGH GRINDER FOR WOOD OIL NUTS, PEANUTS AND HULLING RICE

up with an earth resembling fullers earth and powdered quartz. After boiling for some time, the clear oil is poured off from the sediment. This oil, called *Kuang Yu* —lustrous oil—by the Chinese, is the paint oil of the province.

Chinese lacquer, when applied in the pure state, turns to a jet black when dry. To make use of the valuable properties of the lacquer and avoid its black color, a large percentage of the lustrous wood oil is mixed with the refined lacquer. The result is a transparent varnish with most of the valuable properties of the lacquer. The greatest use for this varnish is for finishing furniture, especially that made in imitation of European goods. For this purpose it is applied as a second coat over a stain of the desired color. If no stain is used, the resultant color is a molasses brown. In either case the varnish retains the properties of lacquer in not showing hot water stains, resistance to scratches and long wearing qualities. It is contended by many writers that this use of the wood oil is an adulteration of the lacquer. However, the addition is for the definite purpose of extending the range of usefulness of the lacquer and should not be classed as adulteration.

The *Kuang Yu*—lustrous oil—is used alone upon furniture as a varnish. When applied to curly or knotted crotch or root wood, a very beautiful satin effect is produced. Sassafras wood is highly esteemed by the Chinese box makers on account of this valuable property. Unfortunately the light lemon color of the first days changes with age to a less pleasing darker shade. However, this is noticed only on the very light colored woods.

Lustrous oil applied to fabrics makes them waterproof. Cotton sheeting to which the oil is applied is used to protect bedding and goods when carried over-

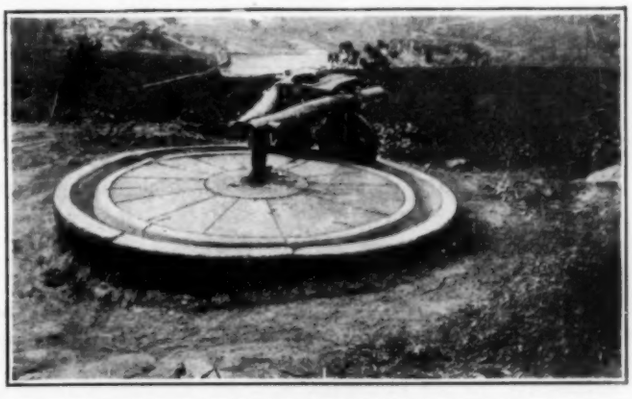


FIG. 7—SMALL-SIZED TROUGH GRINDER

land by coolies. Silk to which the oil is applied makes a fine, light waterproof material which seldom wets through, even in the driving tropical storms. The paper or silk of the native umbrellas is made waterproof by this oil. The use of the oil as a waterproofing agent has enabled the Chinese to get along nicely without rubber goods.

The best Chinese ink is made from the soot obtained by burning the wood oil in a confined atmosphere.

It is said that the wood oil is used in the producing regions as an illuminant. It is, however, so much dirtier and more expensive than the "rape" oil, or *T'sai Yu*, that its use must be limited. Its use has never come to the writer's attention.

Walnut Oil

In the mountain regions of northern Szechuen, the walnut, *Juglans regis*, the nuts of which are practically the same as our English walnuts, is used for its oil. Nothing is reported as to the process of extracting the oil. Much useful knowledge and information on the agriculture side of these oils can be found in Hosie[1] and Wilson[2].

Economics of the Oil Trade

The oils mentioned above are the source of a very large export trade for China. The extent of this trade can be seen from the data in Table I. The figures are for 1918, the last year for which complete data are available.

TABLE I—EXPORT OF VEGETABLE OILS FROM CHINA IN 1918

Kind of Oil	Exports in Pounds—Total	Exports in Pounds—To United States	Approximate Value
Bean, soy	303,622,000	284,900,000	$30,000,000
Cottonseed	17,773,000	16,665,000	1,500,000
Peanut	78,749,000	32,313,000	7,000,000
Rapeseed (T'sai)	740,000	486,000	44,000
Sesamum	2,753,000	658,000	165,000
Tea	3,137,000	165,000	198,000
Wood, tung	65,180,000	32,058,000	6,500,000
All others	14,920,000	3,196,000	9,000,000
Total	486,874,000	370,441,000	$54,407,000

This table indicates that China in all sections does an export trade of about $55,000,000 per year in vegetable oils. Probably not half of the total quantity produced is exported, so that the whole vegetable oil industry probably represents a yearly value of around $125,000,000, which makes it a large industry in China.

Exports Mostly Come to the United States

It is of interest to note that the United States takes about 75 per cent of the total exports. This percentage is increasing. The total trade is constantly increasing and is destined to be of considerable more importance to China as the years pass by.

The export of rapeseed oil is rapidly falling, having dropped from 4,345,000 lb. in 1916 to only 25,000 lb. in 1920. The increasing home consumption of this oil is given as the reason. In the few statistics that are available for 1920 there seems to be a healthy growth in most of the exportations.

Cyanuric Triazide as Primer

At the Pittsburgh, Pa., experiment station of the Bureau of Mines a study is being made of the properties of cyanuric triazide for the purpose of determining its suitability for use as a substitute for mercury fulminate in primers and detonators.

Cutting Massive Copper With the Electric Arc

By A. M. Candy

Arc Welding Engineer, Westinghouse Electric & Manufacturing Co.

IT MAY BE readily appreciated that owing to the great thermal capacity and heat conductivity of copper, it would be necessary to liberate a large amount of electrical energy if copper is to be fused locally, as is necessary for a cutting flame. An actual test showed that a 4½-in. square billet could be cut in 7 minutes using a current of 900 amperes. More massive pieces, such as sometimes result from a furnace accident, would require longer time.

Such a large mass or slab of copper was successfully cut up. The piece was very irregular in shape, but the approximate dimensions were 7 ft. long by 6 ft. 6 in. wide at the extreme points. In the central cut the thickness varied from approximately 1½ in. at the extreme end of the cut to approximately 7 in. maximum at the center of the cut. The average thickness over the 7-ft. length, therefore, would be approximately 4¼ in. This central cut through the slab was completed in approximately 5 hours.

For carrying on such work as this it is necessary to have available for the operator a direct-current generator which will deliver not less than 1,000 amperes through the arc circuit, developing approximately 60 volts. Current is regulated to the best value by cutting in various groups of resistances by an appropriate switch panel.

When carrying on such cutting work, using such large current values of 1,000 amperes, it is very essential

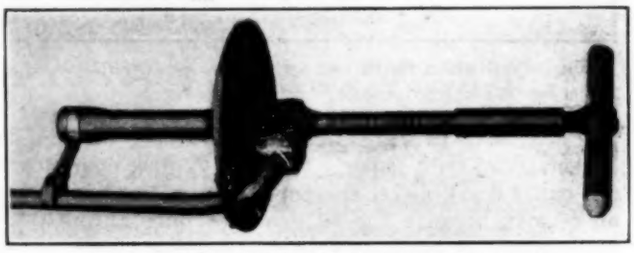


FIG. 1—ELECTRODE HOLDER FOR CARRYING EXTREMELY LARGE CURENTS

that the operator have his body thoroughly protected by closely woven clothing and wear leather gloves on his hands. The head and eyes should be thoroughly protected by a suitable helmet.

Among the most important items is that of an electrode holder which will have a sufficiently cool handle so that the operator can work continuously without experiencing discomfiture of his hands. Such an electrode holder is illustrated in Fig. 1. Current does not pass through the handle, but is carried by means of a supporting lug at one end of the handle and thence through a circular micarta disk and thence up to an aluminum casting at the rear end of the electrode holder proper. The handle is secured independently to the center of the disk, so that there is no metallic connection between the handle and the main portion of the electrode holder proper. By this construction the handle of the holder remains cool at all times.

The graphite electrode is gripped by iron "crows' feet" which are held tightly in place and in contact with the leading in circuit by a metal sleeve. A slight tap will tighten or loosen the combination, when it is necessary to adjust the carbon.

Principles of Blast-Furnace Practice*

"THERE are three principal objects in all blast-furnace practice ranking in importance in the following order—quality, economy and quantity. The first is essential. The second is commercially of great importance. The third is highly desirable, particularly in its bearing on the second. Therefore the object of modern practice is the attainment of the greatest possible quantity consistent with quality."

To justify this thesis, A. K. Reese cites four prime factors underlying the art—viz., preparation of materials, furnace design, auxiliary equipment and method of operation. He shows how each of them contribute to the desired ends.

Preparation of Materials

Satisfactory furnace operation requires an approach to uniformity in chemical and physical reactions throughout the whole cross-section in any zone. This in turn calls for correct distribution of the stock. To effect this much attention must be given to size and texture—coke must be strong enough to resist fracture during handling or crushing under load, and its density and size must not be so great as to prevent rapid combustion. It should be low in ash—since every pound of slag requires ¼ lb. of coke to melt it—low in sulphur and free from fines.

Perhaps the best chance of improvement lies in the preparation of the ore. It must be reducible and uniformly distributed. Dense magnetite may be greatly helped by an oxidizing roast. Few furnaces are troubled with an excess of massive lumps, but these must be crushed to 3- or 4-in. size, not only to allow enough surface so the surrounding gases may reduce the oxide before it enters the fusion zone, but also to permit correct distribution of the ore at the top part of the stack. On the other hand, fine ores clog the charge and produce an excessive amount of dust; they should be mixed with the dust and coke breeze and sintered. This not only produces a porous lump of proper size but also an ore very low in sulphur.

When the material shows not too great variation in size, the next problem is to get it into the furnace in the proper way. Since blast tends to hug the walls, there should be a slight excess of the finer material in this region. It can be placed there with a bell and hopper of correct design when keeping the stack constantly filled to the maximum height. A column of coarse charge surrounded by much finer material should always be avoided, because it would descend most rapidly due to rapid combustion of its fuel. Yet it smelts the slowest because the ore lumps are so large. Consequently half-smelted oxide enters the fusion zone. At the same time, fines along the wall move so slowly they chill and hang to the brickwork, slipping occasionally *en masse*, with pernicious results.

Lastly, air blast is a portion of the charge. It, too, must be as pure as possible and uniformly distributed. If tuyères are properly set, open, and receive an equal amount of wind, the distribution of the gases inside the furnace largely depends upon the condition and distribution of the charge (as outlined above). To get air as pure as possible, inlets to the blowing engines should not be adjacent to short chimneys, steam exhausts or cooling towers. Dry blast is an efficient method of controlling water vapor in the blast, and despite the fact that it has never been widely adopted, is an important factor in making uniform iron. It is impossible to operate with blast temperatures much above 1,300 deg. F. without causing an irregular descent of the ore column, except with dry blast. Given clean gas and modern stoves, the temperature can then be boosted to 1,600 deg. F. without difficulties.

*Abstract of a paper read before the autumn meeting of the British Iron and Steel Institute.

Furnace Design

Passing to the second prime factor underlying modern operations, Mr. Reese says that furnace design is largely a matter of correct adjustment of furnace lines. All the proportions are interdependent to a degree, but "the output capacity of a blast furnace, with any particular set of raw materials, is in proportion to the effective bosh area." He defines the "effective bosh area" as that portion of the full horizontal bosh area at its maximum diameter which is in normal activity. All the modern furnace lines are laid with the idea of keeping the walls clean and thus fully developing this area. Older furnaces about 80 ft. high often have maximum diameters of 19 to 20 ft. Modern, high-capacity furnaces about 90 ft. high have but a slightly larger corresponding dimension—20 to 22 ft. However, the bosh is much lower—in fact, below the zone of fusion. This prevents the pasty mass from scaffolding there. The bosh walls are also much steeper now—built at 80 deg. rather than 70 deg.—so that the material near the walls and above the tuyère line may not be chilled by being withdrawn from a supply of oxygen. Steep low boshes of course demand wide hearths—instead of the old 10 ft. diameter; we now build 16, 18 and even 20 ft.

In the old furnaces, the shaft above the bosh was vertical or had a very slight batter. Now we build a batter of 1 to 14 or 15 in order to provide more room for the free movement of the charge as it descends, gets hotter, pastier, and is compressed by the surmounting load.

A battered shaft means that the upper 20 ft. of the stack—the throat—must be plumb. It is now built slightly smaller in diameter than the hearth—small enough for efficient stock distribution, yet high enough for passage of gas at a velocity not too high. Material is not likely to hang up in this vertical throat, because it is dry and not yet hot enough to become pasty.

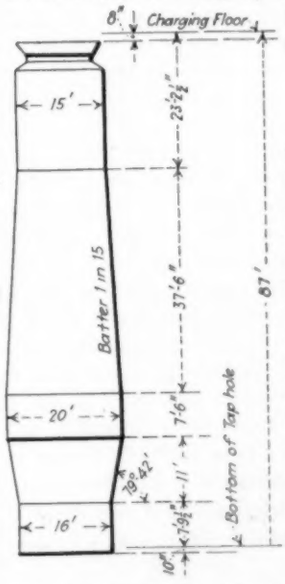


FIG. 1—LINES OF A MODERN BLAST FURNACE

Auxiliary Equipment

Auxiliary equipment comprises the third factor underlying progressive blast-furnace management. Chief among the auxiliaries are the blowers. They should be capable of compressing 40,000 to 50,000 cu.ft. of free air per minute to a pressure of 15 to 20 lb. and of delivering a constant volume under a long overload of at least 30 lb. Centrifugal blowers have been widely adopted since the development of an efficient volume governor, so the volume will not drop as the pressure increases. They are simpler, more compact, cheaper to

build and easier to operate than the reciprocating blowing engine and they deliver the wind without pulsations.

Top gas is discharged from three or four openings to downcomers of ample capacity. Many out-takes prevent channeling in the charge by gas seeking the shortest way out of the furnace. Large out-takes reduce the gas velocity and the amount of dust carried.

Equipment for cleaning this gas of all dust is essential. Burning a dust-free gas saves labor in cleaning boilers or stoves, saves costs for repairs and frequent renewals, permits more continuous and more uniform service through freedom from shut-downs, and permits a more compact redesign of stoves with smaller flues. The modern blast-furnace stove may therefore be made approximately 21 ft. diameter by 100 ft. high, with checker openings 3½ in. diameter, and still possess 80,000 sq.ft. of heating surface.

Efficient mechanical handling of the raw materials is necessary simply because the required number of tons of charge cannot be charged into the furnace by hand. The devices utilized are various—they all must handle the stuff without unduly crushing it or permitting segregation either in size or kind. Sand casting of pig is obsolete, because of the large amount of labor, floor space and clean sand required, and the heavy waste in scrap, either too light or too heavy to market. Furthermore, sand-cast pigs, when remelted, waste iron, fuel and furnace lining. Modern practice demands that liquid iron and slag be removed immediately from the neighborhood of the furnace.

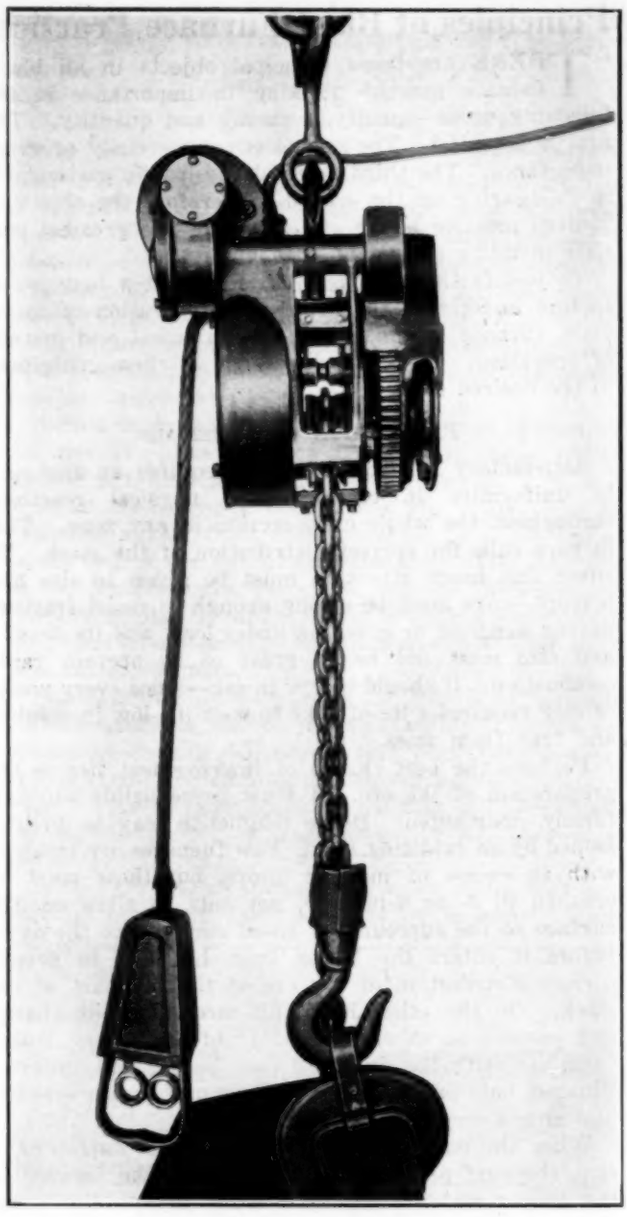
Finally, the fourth principle of modern practice—operating methods—is very hard to define on paper. Many details—such as tuyère location, amount of fuel or amount of cooling water required—are determinable only by experience with varying conditions of charge and weather. It is quite essential, however, that every effort be made to keep the operations steady—especially insuring that a constant *volume* of wind is delivered to the furnace, irrespective of furnace pressure or resistance.

The Motorbloc—A Motor-Driven Chain Hoist

An electrically operated material-handling device, known as the Motorbloc, has been placed on the market by the Motorbloc Corporation of Summerdale, Philadelphia. This new device has been developed to serve the operations lying between the well-defined field of the standard hand chain hoist and that of the traveling electric hoist, with the substantial overhead and electrical installation which its heavy duty requires. It is a readily portable hoist, which can be installed without preliminaries in any location where electric current is available. It is put in service with the facility of an electric drill or vacuum cleaner, and the self-contained pendent controller permits convenient operation as soon as the cord is plugged into the nearest electric circuit.

This hoist consists of a standardized chain hoist of steel construction, electrified by the application of a specially designed heavy-duty motor, proportioned reduction gearing and slip friction clutch, applied by means of a malleable iron supporting bracket comprising a self-contained electrifying unit, to which the pendent controller is also attached. In this way a simple mechanism has been developed for the electrification of the standard spur-geared chain hoist in capacities ranging from ½ ton to 10 tons, proportioned to stand up under severe overloads.

The self-contained, pendent controller is easily



operated by the fingers of one hand, leaving the other hand free to guide the load. This arrangement makes it possible for one man, without physical effort, to accomplish what would otherwise require two or more men for lifting and placing the same load. The portability of the hoist is apparent from the fact that the 1-ton size complete weighs only 148 lb. The armature shaft and worm are carried in heavy duty ball-bearings, and provision has been made for adequate, automatic lubrication. The use of the ring-oiled slip friction clutch prevents damage from overrunning to the hoist parts and chain and at the same time completely protects the motor from overload, without the complication of an electric limit switch.

The accompanying illustration shows the Motorbloc built on a Franklin-Moore all-steel suspension spur-geared chain hoist. For occasional use at points where electric current is not available, or in the event of the temporary failure of electric power, the hand chain can be quickly applied, and the hoist operated as an ordinary block. While regularly furnished as a complete hoisting device, the self-contained electrifying unit can be applied to standard chain hoists already in service.

Tables and Charts for Natural Gas Users

By R. P. Anderson
Chief Chemist, United Natural Gas Co.

NATURAL GAS is one of the most important natural fuels. It has wide industrial use, particularly as fuel for heating furnaces and boilers and for operating gas engines.

Due to its former abundance and relatively low cost little attention has been given up to the present to its efficient use. Now, with the supply decreasing and the price rising, it has become worth while to devote time and study to this phase of the matter. The charts and tables which follow will be useful aids along this line.

Excess Air-CO_2 Curves and Tables

For the purpose of combustion study, natural gas may be considered as consisting of gases of the paraffine series only. When other gases are present in appreciable quantities, corrections must be applied.

In the actual combustion of natural gas, a certain amount of air in excess of the theoretical requirement for complete combustion of the gas must be present, and this quantity of air in the flue gas is known as "excess" air. If the theoretical maximum percentage of carbon dioxide in the flue gas is known (this is the percentage corresponding to perfect combustion without excess air), the percentage of oxygen in the flue gas corresponding to various percentages of carbon dioxide can easily be computed, and data of this kind have been compiled in Table I.

From the percentage oxygen in flue gas as found in Table I and a knowledge of the relation between the carbon dioxide formed and the oxygen requirement of natural gas of given specific gravity the percentage of excess air in flue gas containing a given amount of carbon dioxide can be computed. Such data form the basis of Fig. 1. The computation is made in the following manner: Assume the case of flue gas containing

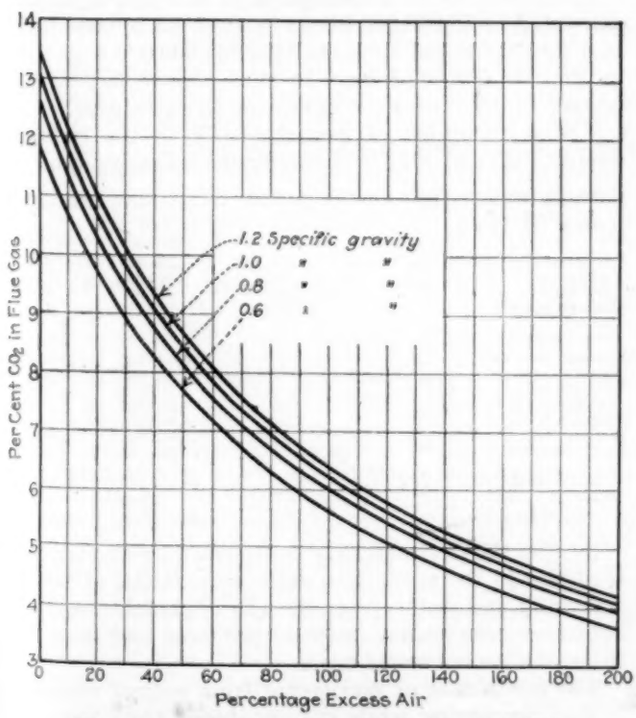


FIG. 1—EXCESS AIR-PER CENT CO_2 CURVES

TABLE I

Per Cent CO_2 in Water-Free Flue Gas	Percentage Oxygen in Flue Gas for Complete Combustion of Gas of Specific Gravity							
	0.60	0.70	0.80	0.90	1.00	1.20	1.50	2.00
1	19.1	19.2	19.2	19.3	19.3	19.3	19.4	19.4
2	17.4	17.5	17.6	17.6	17.7	17.8	17.8	17.9
3	15.6	15.8	15.9	16.0	16.1	16.2	16.3	16.4
4	13.9	14.1	14.3	14.4	14.5	14.7	14.8	14.9
5	12.1	12.4	12.6	12.7	12.9	13.1	13.3	13.4
6	10.4	10.7	10.9	11.1	11.3	11.5	11.7	11.9
7	8.6	9.0	9.3	9.5	9.7	10.0	10.2	10.4
8	6.8	7.3	7.6	7.8	8.1	8.4	8.7	9.0
9	5.1	5.6	6.0	6.2	6.5	6.9	7.2	7.5
10	3.3	3.9	4.3	4.6	4.9	5.3	5.6	6.0
11	1.6	2.2	2.6	2.9	3.2	3.7	4.1	4.5
11.9	0.0	....	....	....	....	....	....	....
12.0	....	0.5	1.0	1.3	1.6	2.2	2.6	3.0
12.3	....	0.0	....	....	....	....	....	....
12.6	....	....	0.0	....	....	....	....	....
12.8	....	....	....	0.0	....	....	....	....
13.0	....	....	....	....	0.0	0.6	1.1	1.5
13.4	....	....	....	....	....	0.0	....	....
13.7	....	....	....	....	....	....	0.0	....
14.0	....	....	....	....	....	....	....	0.0

4 per cent CO_2, produced from the combustion of natural gas of 0.70 specific gravity. By stoichiometrical calculation, 2.45 cu.ft. of oxygen is needed for the combustion of 1 cu.ft. of gas of specific gravity 0.70, and 1.30 cu.ft. of carbon dioxide would be formed. Then the formation of 4 cu.ft. of CO_2 will require 7.54 cu.ft. of oxygen. From Table I, 14.1 cu.ft. of excess oxygen accompanies every 4 cu.ft. of CO_2 and consequently the percentage of excess air will be $\frac{100 \times 14.1}{7.54} = 187$ per cent.

Heat Loss-CO_2 Curves and Tables

The losses of heat in flue gas may be classified under three headings: loss in flue gas proper, loss in excess air, and loss through incomplete combustion.

Heat Loss in Flue Gas—The loss of heat in flue gas proper is due principally, under ordinary conditions, to the heat of vaporization of the water vapor in the flue gas. The total heating value of natural gas in B.t.u. per cu.ft. at 60 deg. F., 30 in. mercury, dry, is given by the following expression, where n represents the average number of carbon atoms per molecule of paraffine hydrocarbons:

$$T.\ H.\ V. = 755.2n + 253.2$$

While the net heating value on the same basis may be found from the formula

$$N.\ H.\ V. = 704.8n + 202.8$$

the difference between the two formulas representing the heat of vaporization at 60 deg. F. of the water formed on the combustion of 1 cu.ft. of gas. If the natural gas contains only paraffine hydrocarbons, these heating values may be expressed in terms of the specific gravity (G) of the gas as follows:

$$T.\ H.\ V. = 1559.7G + 144.6$$

$$\text{and } N.\ H.\ V. = 1455.6G + 101.4$$

The difference between the total and the net heating value for natural gas of four different specific gravities is shown in Table II.

Column C—The data in this column represent the

TABLE II.

Sp.Gr. of Gas	A Heating Value Total	B Heating Value Net	C $\frac{\text{Total-Net}}{\text{Total}} \times 100$	D Per Cent Water Vapor in Flue Gas	E Minimum Temp. Flue Gas, Deg. F.	F Sensible Heat Loss, Per Cent	G Total Heat Loss, Per Cent
0.6	1,080	975	9.7	18.5	138	1.6	11.3
0.8	1,392	1,266	9.1	17.3	135	1.5	10.6
1.0	1,704	1,557	8.6	16.6	134	1.5	10.1
1.2	2,016	1,848	8.3	16.0	132	1.4	9.7

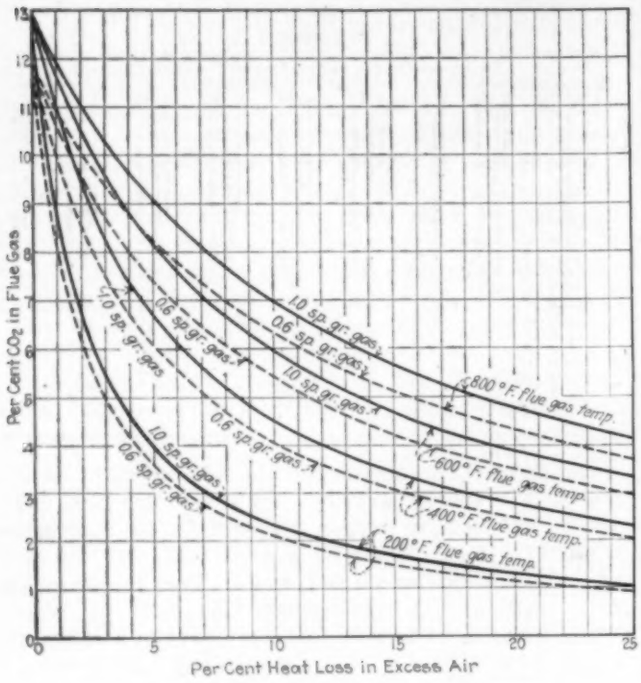

Per Cent CO_2 in Flue Gas
Per Cent Heat Loss in Excess Air
1.0 sp. gr. gas
0.6 sp. gr. gas
800° F. Flue gas temp.
600° F. Flue gas temp.
400° F. Flue gas temp.
200° F. Flue gas temp.

FIG. 2—HEAT LOSS-PER CENT CO_2 CURVES

percentage of the total heat in the gas that is lost in the water vapor formed on combustion.

Column E—The temperatures in this column correspond to the partial pressures of water vapor in flue gas, assuming a barometric pressure of 760 mm.

Column F—These data represent heat loss in flue gas constituents escaping at temperatures of column E rather than at 60 deg. F. Volumetric specific heat of nitrogen taken as 0.018 B.t.u. per cu.ft., of water vapor 0.022 B.t.u. per cu.ft., and of carbon dioxide 0.024 B.t.u. per cu.ft.

Column G—This column is the sum of columns F and C.

The loss of heat in flue gas proper, resulting from its leaving the appliance at a temperature higher than that of the entering air and gas, depends of course upon this temperature difference as well as upon the nature of the gas burned. It is generally desirable to cool the flue gas as much as possible before it leaves the appliance in order to avoid unnecessary heat losses, but where condensation of water in the appliance is undesirable, the flue gas must be allowed to leave the appliance at a temperature such that the percentage of water vapor in the flue gas will not exceed the saturation point.

It will be noted from Table II that this limiting temperature varies from 132 to 138 deg. F. if no excess air is present and that the heat loss which is unavoidable under these conditions amounts to from 9.7 to 11.3 per cent of the total heat of the gas, depending upon its specific gravity.

Heat Loss in Excess Air—The loss of heat due to excess air has been computed for different percentages of carbon dioxide for natural gas of specific gravity 0.60 and 1.00, and for flue gas temperatures of 200, 400, 600 and 800 deg. F. and the results have been shown graphically in Fig. 2. The volumetric specific heat of air was taken as 0.018 B.t.u. per cu.ft. in making these calculations.

Heat Loss Through Incomplete Combustion—The loss of heat through incomplete combustion of natural gas can be ascertained only through knowledge of the nature and quantities of the combustible constituents in the products of combustion, and this information is not usually available. Where combustion is nearly complete, carbon monoxide may be assumed to be the principal combustible constituent of the flue gas and the approximate heat loss due to the presence of 1 per cent of this constituent in the flue gas formed from the combustion of natural gas of 0.70 specific gravity will be about 3 per cent of the heating value of the gas, if the flue gas does not contain much excess air.

The Danish Margarine Industry During 1921

The total number of margarine-manufacturing plants in Denmark in 1921 was 67, as compared with 64 in 1920 and 50 in 1919, according to an issue of the *Berlingske Tidende*, published in *Commerce Reports* for Aug. 14, 1922. The number of plants as compared with pre-war figures shows an increase of nearly 50 per cent. The greater number of plants have, however, a comparatively small production capacity, as only 9 of the 67 produce over 1,000,000 kilos per year, while 39 have a yearly production of less than 100,000 kilos. During 1921 the industry gave employment to 1,060 workers, of which 760 were men and 300 were women or minors.

The production during 1921 amounted to 55,700,000 kilos, of which 6,400,000 kilos were from animal ingredients while the rest was produced from vegetable oils. The total value of the year's production is estimated at about 96,000,000 crowns. The 1920 production amounted to 55,500,000 kilos valued at 146,000,000 crowns. The drop in prices was exceedingly heavy during 1921. While during the normal years prior to 1917 there was an excess of imports of from 1,500,000 to 2,000,000 kilos per annum, the years following 1918 have witnessed a very small importation. The imports in 1919 amounted to 300,000 kilos; in 1920, 440,000 kilos; and in 1921, 508,000 kilos. Exportation during 1919 amounted to 1,500,000 kilos; 1920, 2,300,000 kilos; and in 1921, 506,000 kilos.

The total Danish consumption of margarine in 1916 amounted to 58,060,000 kilos; in 1917, 33,200,000 kilos; in 1919, 38,400,000 kilos; in 1920, 54,000,000 kilos; and in 1921, 56,000,000 kilos. In 1918, due to lack of raw materials, practically no margarine was produced.

The consumption of raw materials in the industry during 1920 and 1921 is shown by the following table:

RAW MATERIALS USED IN THE DANISH MARGARINE INDUSTRY

Kinds of Oil Used	1920 Kilos	1921 Kilos
Oleomargarine	550,000	790,000
Premier jus	1,910,000	2,080,000
Neutral lard	430,000	500,000
Other animal oils	90,000	170,000
Total animal oils	2,980,000	3,540,000
Coconut oil	30,000,000	29,320,000
Palm fat	720,000	760,000
Arachid oil	1,580,000	1,240,000
Cottonseed oil	3,650,000	5,590,000
Sesame oil	4,590,000	4,180,000
Soy bean oil	2,640,000	1,540,000
Hardened oil	850,000	870,000
Total vegetable oils	44,030,000	43,500,000
Mixed oils	10,000	10,000
Grand total	47,020,000	47,050,000

Besides the raw materials enumerated above there are used also in the production certain quantities of butter, salt, milk and water from the use of which comes the difference between the quantity produced and the quantities of raw materials used.

The production of margarine from animal materials is fast decreasing while that produced from vegetable matters is increasing.

Book Reviews

L'AZOTE. LA FIXATION DE L'AZOTE ATMOSPHÉRIQUE ET SON AVENIR INDUSTRIEL. By *L. Hackspill*, professor of chemistry at Strasbourg. Published by Masson & Cie., Paris. 275 pages.

The author demonstrates that there is a national and world need for the synthesis of compounds of nitrogen and that such a process would accomplish national security and economies in peace and in war. Each nitrogen cycle, natural and artificial, is carefully considered and its relative merits and disadvantages are estimated. The experimental results obtained in France and in other countries are freely discussed.

The synthesis of ammonia is particularly well treated because of the unique qualifications of Dr. Hackspill. He had had a personal acquaintance with the preliminary experiments of Le Chatelier and of La Rossignol upon the so-called Haber process; he was associated with M. Guichard in the French investigations upon this process during the war; and he has a friendly knowledge of the Claude process. The position as officer in charge during the French occupation of the German Haber process plant at Oppau enabled Captain Hackspill to see and learn interesting details which he now reveals.

It is popular and non-mathematical in its style and may be understood by a beginner in chemistry. It has the French charm of perspicacity and precision. RESTON STEVENSON.

LEHRBUCH DER EISEN- UND STAHLGIESSEREI. By *Bernhard Osann, professor* at the Clausthal School of Mines. Fifth, revised edition. 693 pp., 758 illustrations. Publisher, Wilhelm Engelmann, Leipzig.

It would be useless to give a price for the book. The fourth edition, dated July, 1920, cost 42 marks in paper or 54 in cloth. A circular describing the fifth edition showed the prices 620 and 800 marks respectively, but before it could be issued a rubber stamp was affixed showing the revised price to be 650 marks in paper or 950 marks when cloth bound. Since the cost of German marks at this moment is 1¾ cents per hundred, the bound book at the revised price would cost just 17 cents in American money. However, it will probably cost about $3.50 through an importer.

The fourth edition, which was reviewed favorably and at length by Richard Moldenke in our issue for March 23, 1921, was evidently very popular. The fifth, now at hand, has been reset, but only very minor changes are to be found. Brief notes on what has happened in the 2 years are given room by cutting out obsolete material in the earlier edition. Fortunately for the usefulness of the book to Americans, a new and much more extensive index accompanies the text.

E. E. THUM.

Recent Chemical & Metallurgical Patents

American Patents

Issued Oct. 31 and Nov. 7, 1922

The following numbers have been selected from the latest available issues of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.*'s staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,433,533—Production of Arsenic.
1,433,634—Collecting Main for Coke Ovens.
1,433,654—Recovery of Sucrose.
1,433,655—Recovery of Sucrose.
1,434,047—Method of Uniting Metals.
1,434,089—Counter-current Washing Device.
1,434,090—Settling Apparatus.
1,434,650—Manufacture of Calcium Arsenate.
1,434,892—Manufacture of Vulcanized Rubber.
1,434,908—Process of Vulcanizing Rubber.
1,434,909—Process of Vulcanizing Rubber.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Dehydrating Pyridine—In the refining of pyridine, the crude water solution is usually salted out to effect a preliminary separation of the water. For this purpose ammonium sulphate or sodium chloride may be used. The pyridine is not very soluble in the concentrated water-salt solution. The salt solution separates by gravity from the pyridine, in which it is immiscible. The supernatant pyridine, which is then drawn off, contains considerable water, often as much as 15 to 20 per cent. It is the purpose of the process described in the present patent to complete the dehydration in a practical and economical way. The crude pyridine solution is charged into a still and heated. The first portion of the distillate is a constant boiling mixture of pyridine and water, in the proportion of three mols of water to one of pyridine. This distillate is, therefore, much richer in water than was the original still charge.

The distillate is passed over a suitable soluble salt, such as ammonium sulphate. Ordinarily this salt does not complete the dehydration in the distillate, but is used because it is cheap and readily available in a byproduct coke plant. The vapors and condensate are passed over a mass of ammonium sulphate crystals to form a saturated solution, giving two liquid phases; one the saturated solution of ammonium sulphate and the other the pyridine from which most of the water has been extracted. This is passed into a separator, where the water layer is trapped out and from which the pyridine layer is returned to the still. The distillation and dehydration with ammonium sulphate are continued until the distillate no longer forms a water solution when in contact with ammonium sulphate crystals. When this point is reached, the charge in the still is completely dehydrated. (1,416,205, assigned to the Koppers Co., of Pittsburgh, Pa.; May 16, 1922.)

The Aluminum-Chloride Method of Cracking Petroleum Distillates—Probably the most important single patent issued in recent months is that granted to Almer M. McAfee, of Bayonne, N. J., and assigned to the Gulf Refining Co., of Pittsburgh. The patent has for its purpose the specification of a process of converting high-boiling petroleum oils into high-grade low-boiling products of the nature of gasoline, etc., by means of anhydrous aluminum chloride. The original application was filed Sept. 30, 1913, and the patent was issued Aug. 1, 1922.

The process may briefly be outlined as follows: A high-boiling oil is subjected to long-continued heat at a temperature below "cracking temperature" but sufficient to cause reaction to take place in the presence of aluminum chloride. Low-boiling products are formed which are removed from the reaction as fast as produced and proportionate quantities of fresh oil are added to maintain the volume and at the same time to keep the concentration of aluminum chloride practically constant. It is the claim of the inventor that, in contradistinction to the usual cracking methods, substantially complete results are obtained—that is to say, 80 to 85 per cent of the original oil reappears in the form of a water white, sweet, low-boiling oil of substantially saturated character needing little or no refining before being marketed as gasoline or kerosene.

The use of aluminum chloride in petroleum refining has been proposed by others, but it is stated that the results have never been entirely satisfactory, principally because the reaction conditions have never been carefully controlled. Aluminum chloride has a marked tendency to produce resin and tar, and in certain cracking processes in which it has been used, a very large production of gas and heavy oils has been obtained instead of a production of light oil, such as is desirable for motor fuel.

In the McAfee process, a substantially uniform concentration of aluminum chloride is maintained in the oil under treatment and the low-boiling

products formed by its catalytic action are removed from its sphere of influence as fast as they are formed, in order to prevent retrogressive changes. This is accomplished by feeding in new or fresh oil as fast as the low-boiling materials are removed from the reaction. Furthermore, the whole mass must be kept in vigorous agitation throughout the process, in order to prevent the formation of insoluble coky bodies by the aluminum chloride. Provision is also made to condense and return to the reaction the vapors of high-boiling oil, as well as any aluminum chloride which may itself vaporize. This is not only useful in maintaining the concentration of the aluminum chloride in the body of the oil, but also has the further advantage of condensing the gasoline being formed.

The particular temperature which is desirable in the oil mass will vary with the constitution of the petroleum oil being treated, but as a general rule the temperature will not rise above 500 deg. F., even in the case of very high-boiling oils.

The oils and apparatus should be free of water, air or dissolved oxygen. Both moisture and oxygen lead to the production of undesired side reactions as well as decomposing the aluminum chloride. The process may be used on any crude petroleum or on any high-boiling residual oil, such as fuel oil, still bottoms, etc. High-boiling distillates like gas oil and lubricating oil may be treated by the present process to make low boiling products. The aluminum chloride employed may be any commercial preparation, but should be anhydrous. (1,424,574. Aug. 1, 1922.)

Aluminum Alloy of High Strength—Francis C. Frary, of Oakmont, Pa., notes that certain aluminum alloys, containing about 4 per cent Cu, about 0.5 per cent Mg and with or without about 1 per cent Mn, are known to have very valuable properties; notably that by heat-treatment they acquire the tensile strength of mild steel and retain elongations of 10 to 20 per cent in 2 in. These alloys are very hot-short and are difficult to roll into sheets, cracks start at the edges and necessitate deep shearing and much discard. He finds that an alkaline earth metal cures this defect, retaining the other excellences of the metal, even increasing the facility of working in the cold. He recommends an analysis Cu 4.0, Mn 0.6 to 1.0, Mg 0.3 to 1.0, and Ca 0.3 to 0.6 per cent, remainder aluminum. Alloys of this family are easily made by melting ingot aluminum, 99 per cent pure, in a crucible with correct amounts of an 80:20 Al:Cu alloy and a 92:8 Al:Mn alloy, care being taken that the temperature does not exceed 1,500 deg. F. The crucible is then removed from the fire, a correct amount of metallic magnesium and an 80:10:10 Al:Ca:Cu alloy added, dissolved and thoroughly stirred. After reheating and skimming the alloy is cast into ingots. (Original 1,412,280, April 11, 1922. Reissued July 11, 1922, as No. 15,407. Assigned to Aluminum Co. of America.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Depilating Hides—The process set forth in the parent specification (Br. Pat. 175,314) for depilating hides or skins by means of gaseous ammonia in certain concentrations is improved by defatting the skins prior to or in the early stages of the ammonia treatment. In addition, the flesh sides of the skins are protected from the action of the ammonia, warmed concentrated ammonium hydroxide solution is used instead of steam to maintain the necessary degree of moisture in the chamber, the hides or skins and the gaseous or vaporous contents of the chamber are kept in relative movement and the unconsumed ammonia is expelled from the chamber by warm air or other warm gases which do not react with ammonia. The skins may be defatted by extraction with solvents, by saponification with alkali solutions or by regulating the temperature of the chamber in the initial stages of the ammonia treatment so as to effect saponification with the production of ammonia soaps. To protect the flesh sides, two skins may be placed in contact or the flesh sides may be provided with coatings impervious to ammonia. The unconsumed ammonia expelled from the chamber may be absorbed in cold water and concentrated for use in maintaining the required degree of moisture. (Br. Pat. 182,240. O. Richter, Brandenburg. Aug. 23, 1922.)

Synthetic Resins — Artificial resins produced by heating aldehydes with alkali are rendered stable toward water by dissolving them in a solvent and then precipitating them, preferably by water. If the initial resin has not been condensed as far as the hard stage, hardening may be effected by prolonged heating after the precipitation. The products may be used as protective paints for radiators, boilers, etc., being soluble in alcohol, benzene, carbon tetrachloride, trichlorethylene, acetone and fatty oils, such as linseed oil. They are also useful for the production of oil and spirit varnishes, impregnating or polishing solutions. According to the examples, (1) acetaldehyde and alkaline lye are subjected to continued heating after distilling off the volatile residue, the product dissolved in glacial acetic acid and then precipitated in powder form by the addition of water; after drying, the powder may be directly dissolved in a solvent to form a varnish or first converted by more or less prolonged heating into a resin of desired degree of hardness; (2) a viscous resin is formed from crotonaldehyde and alkaline lye, dissolved in acetone and precipitated by adding water; the precipitated resin is then hardened by heating it alone or dissolved in a solvent such as linseed oil. (Br. Pat. 182,459; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Aug. 23, 1922.)

Synthetic Resins—Diazo compounds are incorporated with the resinous condensation products of phenols with aldehydes or of ketones with aldehydes, preferably before the condensation is complete. The resulting materials are resinous in character and can be used as oil-soluble dyestuffs, as a shellac substitute, for electric insulation or in pyrotechnics for making artificial flames; they may also be employed as fat- and oil-soluble varnishes for paper, textile fabrics and leather, or to produce a bright, hard, polishable coating on wood, metals, etc. According to the examples, (1) melted phenol and hexamethylenetetramine are stirred together, while diazotized *p*-nitraniline is added; the product solidifies on cooling to a green- or orange-colored oil-soluble resin; instead of hexamethylenetetramine, formaldehyde, paraformaldehyde or furfural may be used, while cresol or other hydroxy-benzenes, or chlorinated phenols, may replace the phenol; (2) acetone and formaldehyde are condensed by the aid of potash, and diazotized *p*-nitraniline is then added to the oily liquid. (Br. Pat. 182,497. H. Plauson, Hamburg. Aug. 23, 1922.)

Ferric Oxide—Red iron oxide suitable for use as a pigment is obtained by heating ferrous chloride in a current of air and steam. The ferrous chloride, preferably in granular form obtained by evaporating pickle liquor while stirring, is spread on the floor of a muffle furnace and air moistened by passing through water at 60 deg. C. is heated to 250 to 300 deg. C. and passed over it. The exit gas is cooled to obtain hydrochloric acid, and the rate at which the current is passed should be such that the acid condensed contains not more than 30 grams HCl per 100 c.c. The gases leaving the condenser are passed to a scrubber fed with water or pickle liquor. Iron compounds decomposable under the conditions of the process, such as hydrated ferric oxide or ferrous carbonate, which may be in the natural condition, may be mixed in finely divided form with the ferrous chloride, and in that case the temperature may be carried higher — for instance, to 350 deg. C. There may also be added to the ferrous chloride small quantities of salts having a catalytic effect—namely, salts of copper, magnesium, tin, sodium and potassium. The addition of a copper salt is stated to improve the red color of the product. (Br. Pat. 183,323. D. Tyrer, Stockton-on-Tees. Sept. 13, 1922.)

Dyeing Cellulose Acetate—Cellulose acetate threads, films or fabrics, or mixed goods containing it, are treated, prior to or during dyeing, by means of trisodium phosphate solution. In an example, acetate silk is treated at 60 to 70 deg. C. in a bath of disodium phosphate and caustic soda. The treated silk may be mordanted with tannin and tartar emetic before dyeing. (Br. Pat. 183,806; not yet accepted. Soc. Chimique des Usines du Rhone, Paris. Sept. 20, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

American Institute of Chemical Engineers Plans Big Program for Richmond Meeting

Fifteenth Annual Convention Gives Promise of Important Technical Sessions and Interesting Inspection Trips

THE PROGRAM for the fifteenth annual meeting of the American Institute of Chemical Engineers has been approved by the Council. It will be held in Richmond, Va., Dec. 6 to 9, with headquarters at the Hotel Jefferson. The New York delegation will go down in special Pullman cars leaving the Pennsylvania Station at 8:45 p.m. and reaching Richmond at 7 o'clock the next morning.

Materials of Construction

The feature of the technical papers will be a comprehensive survey of materials of construction. Papers have been prepared on wood, chemical stoneware, glass, cement and lime and their use in chemical industries. In addition papers on such new developments as magnesium oxychloride, cement and ductile tantalum will be presented.

One of the outstanding papers of the program will be that of J. H. Young of the Mellon Institute on "Asbestos-Protected Metal and Its Use." This represents several years of extensive investigation at the famous Pittsburgh laboratory.

Attractions of Richmond

Mayor George Ainslie will welcome the Institute to Richmond, and Director of Public Works Allen J. Saville will make an address on the advantages which Richmond offers to chemical industries. The Institute will have opportunity to investigate these industries: The fertilizer plants of the Virginia-Carolina Chemical Co., the Richmond Car Works, the Standard Paper Co., and finally the industry which in the public mind is most intimately associated with Richmond — tobacco.

An automobile excursion to Hopewell and Petersburg will include an inspection of some of the Hopewell industries in the morning, a luncheon and a drive back through historic Petersburg in the afternoon.

The secretary of the Institute, J. C. Olsen, the Polytechnic Institute, Brooklyn, N. Y., will make reservations for the special Pullmans which go from New York to Richmond. Hotel reservations should be made direct to the Hotel Jefferson, Richmond.

The local committees have been very active and their energy and interest promise an enthusiastic meeting. The committees are as follows:

General Committee—John G. Armistead, chairman; W. T. Dabney, Dr. J. B. Robb, Graham Edgar.

Committee on Plant Visits—Dr. F. C. Carpenter, George H. Nash, A. G. Ryland.

Committee on Papers Concerning Richmond—Dr. Julius B. Weems, Dr. Samuel H. Sheib, Henry Froehling.

Committee on Entertainment—W. F. Rudd, J. G. Armistead, A. H. Allen, A. G. Ryland.

Committee on Hopewell-Petersburg Trip—John G. Armistead, A. H. Allen.

Gentlemen's Entertainment Committee—James F. Ryland.

Ladies' Entertainment Committee—Mrs. J. Allison Hodges.

Wednesday, Dec. 6

Meeting at Hotel Jefferson

9 a.m. Registration.

9:30 a.m. Address of welcome by George Ainslie, Mayor.

"The Advantages Richmond Offers to Chemical Industries," Allen J. Saville, Director of Public Works.

Symposium on Materials of Construction.

"Wood," J. V. N. Dorr, president of the Dorr Co.

"Application of Stoneware to the Chemical Industry," P. C. Kingsbury, chief engineer, General Ceramics Co.

"Ductile Tantalum," Dr. Clarence W. Balke, chemical director of the Fansteel Products Co., Inc.

"Magnesium Oxychloride," Max Y. Seaton, technical director, National Kellastone Co.

"Glass Rings—A New Filling Material for Towers," F. C. Zeisberg.

"Glass," A. E. Marshall. (One-half hour) Lantern slides.

12:30 p.m. Luncheon at Hotel Jefferson, $1.25.

2 p.m. Excursions. Optional trips.

1. Seeing Richmond.
2. Inspection of Standard Paper Manufacturing Co.
3. Richmond Car Works.
4. Southern Manufacturing Co. (baking powder).
5. Cheek-Neal Coffee Co. plants.

8:30 p.m. Reception and entertainment.

Thursday, Dec. 7

9 a.m. Business session. Canvass of ballots for officers. Reports of officers and Council. Reports of committees.

10 a.m. Papers.

"Effect of Rate of Flow on Absorption of Gases," Wallace B. Van Arsdel, chemical engineer, Brown Co.

"Resistance of Packing to Fluid Flow," F. C. Blake, E. I. du Pont de Nemours & Co.

"Absorption and Scrubbing Tower Design," R. T. Haslam, Massachusetts Institute of Technology.

"Integral Waterproofings for Concrete," Prof. A. H. White.

"The Density of Lime as a Function of Burning Conditions," Gerard Osterhof and Prof. J. R. Withrow.

"Defects of the Patent Laws in the United States," Maximilian Toch.

"Tobacco Industry of Richmond," Thomas M. Carrington, president Tobacco Association of the United States.

12:30 p.m. Luncheon.

2 p.m. Excursions.

Inspection of Allen & Ginter division of Liggett & Myers Tobacco Co. (cigarettes).

Whitlock branch P. Lorrilard Tobacco Co. (cigars).

Larus Bros. & Co. (smoking and chewing tobacco) plants.

8 p.m. Papers—Hotel Jefferson.

"Asbestos-Protected Metal, Its Development, Manufacture and Use," Dr. J. H. Young, senior fellow, Mellon Institute. (Illustrated by slides.)

"The Uses of Concrete in Chemical Works," A. C. Irwin, engineer, Portland Cement Association.

Friday, Dec. 8

9 a.m. Business.

10 a.m. Papers.

"Oil Substitution Products, W. B. Pratt.

"Some Engine Experiments With Oxidized Oils," J. H. James. (Lantern.)

"Use of Propane for Refrigeration," H. D. Edwards, Linde Air Products Co.

"A Method for the Analysis of Stirrer Performance and Its Application to a Common Type of Paddle Stirrer," J. C. Wood, E. R. Whittemore and W. L. Badger.

"Purification of Sewage by Aëration in the Presence of Activated Sludge—IV.", Edward Bartow.

"The Importance of Impurities," Jerome Alexander.

12:30 p.m. Luncheon.

2 p.m. Excursions.

Inspection of Virginia-Carolina Chemical Co.'s Richmond Chemical Works (complete fertilizers), Richmond Cedar Works (woodenware) plants.

7 p.m. Subscription dinner, Hotel Jefferson (informal), $4.

Saturday, Dec. 9

8:30 a.m. Excursion to Hopewell and Petersburg, where the following plants will be visited: The Stamsocott Co., Hummel-Ross Fibre Corporation, Hopewell Chemical Co., Water Purification System.

Fatal Explosion at Columbia Kills Graduate Student

William E. Spandow Instantly Killed and Reginald G. Sloane Injured by Bursting Autoclave

An accidental explosion Nov. 17 in the chemical engineering laboratories of Columbia University resulted in the death of William Eastman Spandow, a graduate student from the University of Denver, and in serious injury to Reginald Gordon Sloane, a Harvard graduate. The students were experimenting on a semi-technical scale in the manufacture of diphenylamine. The experiment was proceeding in a normal manner when suddenly the pressure mounted and before it could be released the top was blown off the heavy steel autoclave and shattered into pieces which were hurled in all directions, imperiling the lives of at least seven other students at work in the laboratory. Spandow, who was standing directly over the instrument in order to read the pressure gage, was hit by a heavy piece of steel which crushed his head, killing him instantly. Sloane had been assisting in the experiment and was a short distance from the autoclave when it exploded. He was painfully burned by the chemicals plastered over his face and eyes, his scalp and face were cut by flying missiles and he was badly bruised.

The force of the explosion was sufficient to do considerable damage, principally to the windows and glass apparatus and equipment.

Had Been Tested for 750 Lb.

The apparatus, which had previously been used for this and other experiments, was a heavy steel autoclave having a capacity of 2 gal. It was about 2 ft. high, 1½ ft. in diameter and had been tested for a pressure of 750 lb. per sq.in. The lid, about 2 in. thick, was held in place by twelve lugs, six of which were sheared off even with the flange. The bolts were broken or threads stripped on the others. The lid was broken into hundreds of pieces, the largest probably not weighing more than 10 lb.

The force of the explosion was mostly expended vertically. A large hole in the wooden floor of the balcony directly above the apparatus indicated the path of part of the flying steel.

The experiment on which Spandow and Sloane were engaged was the production of diphenylamine by the standard commercial method. Aniline and aniline hydrochloride were being heated at 240 to 260 deg. C. for 24 hours to form diphenylamine, ammonia and hydrochloric acid. This was one of a series of preparations which go to make up a course in the manufacture of dye intermediates and organic chemicals. Under the direction of Prof. Arthur W. Hixson this course has been one of the most popular in the chemical engineering school. Its purpose is to give the student experience in actual chemical manufacture on a scale approximating semi-commercial practice. This particular experiment, the preparation of diphenylamine, had been successfully carried out by students in the preceding classes. The aniline used was the commercial product taken directly from the shipper's drum. The aniline hydrochloride had been made by Spandow and Sloane from this same aniline and had been purified and thoroughly tested.

Sloane's Account of Accident

Spandow and Sloane began their experiment about 11 o'clock and were heating up the autoclave by means of the gas heater directly beneath it. The reaction was proceeding normally and by means of its valve the apparatus had been vented twice in order to remove any air or oxygen it contained. At about 12:20 Professor Hixson read the gage, which then showed a pressure of 112 lb., and after warning the students to turn off the gas in case the pressure increased, he started for lunch. Before he had left the building, however, the explosion occurred and he rushed downstairs and assisted the students in giving first aid to Sloane.

In giving an account of the accident Sloane said that the gage had shown a sudden rise of pressure, from 112 to about 250 lb. per sq.in., and that he had hurried to the cock 20 ft. away and turned off the gas supply. Returning, he saw Spandow opening the valve on the autoclave and apparently this act was followed by the explosion. The theory has been advanced that the flame, not yet completely extinguished in the gas burner, ignited the escaping gases and shot back into the chamber to cause the explosion.

Paint and Varnish Makers Meet

Four Associations Hold Conventions in Atlantic City

Well-attended and enthusiastic meetings characterized the convention of paint and varnish associations in Atlantic City, Nov. 15 to 17. The four national organizations of the paint and varnish industries—the National Paint, Oil and Varnish Association, the National Varnish Manufacturers' Association, the Paint Manufacturers' Association of the United States and the Federation of Paint and Varnish Production Clubs—held simultaneous conventions, and the opportunity for association and social intercourse offered by the assembly of so many representatives of the trade in "America's Playground" was no less valuable than the business sessions.

Business Good

Ernest T. Trigg, president of the National Paint, Oil and Varnish Association, sounded a keynote of optimism at the opening session of the convention, saying that in the 4 years since the armistice, American business has reached a degree of stability that it took Europe 40 years to reach after the battle of Waterloo. The whole business life of the present generation, said President Trigg, must be devoted to the task of world reconstruction to make good the wastes of the war.

"The paint and varnish industry," he said, "more than all others, as the industry of preservation, is the very incarnation, in spirit and substance, of the things needed to combat the waste of those years that were dedicated to destruction and waste."

Arthur E. Foote, of the division of simplified practice of the Department of Commerce, addressing the National Paint and Varnish Manufacturers' Association, expressed the desire of the Department of Commerce to co-operate with the trade. He stressed the importance of standardization in eliminating waste, saying:

"Business men should realize that the Department of Commerce is at their service and that the government's only object in creating the simplification of practice movement is to eliminate waste. Over one hundred different industries throughout the country are considering simplified practices, and when the tremendous value of this movement is realized there will be many more."

Industrial Alcohol

A resolution requesting the Commissioner of Internal Revenue to issue reasonable restrictions to insure ample supplies of alcohol to the industry was drawn up as a result of a report by a committee of the N. P. O. and V. A.

Flaxseed Situation

A. C. Dilman, of the U. S. Department of Agriculture, discussed the flaxseed situation in this country as a factor of vital importance to the paint industry.

For the past 10 years, he said, production of flaxseed in the United States has averaged only a little over one-half the quantity consumed, so that considerable imports have been necessary.

Mr. Dilman told how this shortage can be overcome by growing combination crops of flax and wheat. He told of the successful experiments in this direction in Minnesota, and said that climatic conditions make similar combination crops possible in other states.

Election of Officers

Officers of the four associations were elected as follows:

National Paint Oil and Varnish Association: President, Louis R. Atwood; vice-presidents, E. V. Peters, J. W. Bray, Sydney Rasmussen, H. J. Kuhn, George Henderson; treasurer, John H. Pine; secretary, George V. Horgan.

National Varnish Manufacturers' Association: President, Henry L. Calman; vice-presidents, C. J. Roh, W. R. Carnegie.

Paint Manufacturers' Association of the United States: President, Charles L. Cook; vice-presidents, S. R. Matlack, Samuel Rosenthal; secretary-treasurer, G. B. Heckel.

Federation of Paint and Varnish Production Clubs: President, E. W. Fasig; secretary-treasurer, G. B. Heckel.

Weeks Recognizes Peace-Time Value of C.W.S.

War Secretary Points Out Important Sanitary and Industrial Applications of Poison Gases

Peace-time activities of the Chemical Warfare Service were discussed as follows by John W. Weeks, the Secretary of War, in the course of an address before the Boston Chamber of Commerce:

"Does the average citizen know that the deadly mustard gas, as well as several other war gases, is being employed experimentally with great hopes of its proving a valuable retardant in the treatment of tuberculosis?" Contrary to the popular impression that the poison gas causes respiratory diseases, he continued, it has been established that it tends to prevent such diseases. "Among the employees of large war gas factories, influenza and similar diseases were practically unknown during the period of the plagues that swept our country at the close of the world war. Extensive arrangements are being made in the laboratories of the Chemical Warfare Service to conduct research into the fields of medical employment of war gases and byproducts."

Extermination of Vermin

One of the greatest problems of modern sanitation is that of effective and safe fumigation. It is necessary to wage continuous war against the rats and other vermin which carry plagues. Only recently, in the fumigation of a ship in San Francisco, several men were killed and many injured by the fumes of hydrocyanic acid. The Chemical Warfare Service offered its co-operation and has already given promise of solving this problem. Tear gas was finally selected as the best possibility for use in fumigation. Near the end of October a test was made with a concentration of one-eighth the strength which would injure human life. Several officers spent the night in a room adjoining the kitchen which was selected for the test. The gas was projected into the kitchen in the evening, and the officers in the next room reported that they were not inconvenienced thereby. In the morning it was discovered that every mouse, fly, cockroach and other insect was dead. The gas was then projected into a large warehouse, killing hundreds of rats, mice, bats and other vermin. The experiment was repeated in fumigating a ship and the results were beyond expectations. The Public Health Service is enthusiastic about this work and the possibilities seem limitless.

Industrial Value

Tear gases have also been demonstrated as very effective in employment against barricaded criminals and in attempted jail deliveries and other riotous actions. The gas mask is becoming very valuable for use in mining activities. The Chemical Warfare Service has produced the only substance suitable for protection of miners against the deadly carbon monoxide gas. In their development of gas masks and suitable materials therefor, the scientists of the Chemical Warfare Service have made another valuable contribution to the industries in the form of a very active charcoal which is useful in manufacturing gasoline from natural gas and coal-tar products.

Boll Weevil Control

It is becoming recognized that any effective control of the boll weevil and similar pests must come from the use of these poisonous compounds. The Air Service is co-operating in experiments by spraying the fields and orchards with the vapors. Experiments are being conducted by the Chemical Warfare Service in co-operation with the Navy Department in hopes of producing a non-fouling paint and thereby avoiding the results of barnacles which gather on ship bottoms. Gases are being used in experiments with the hope of destroying the teredo and limnoria, which bore into submerged timbers in our southern waters. Finally, in addition to all of these constructive activities, one must recognize that the work of the Chemical Warfare Service has led the way to the foundation of an American dye industry that should one day be one of our most valued assets.

R. E. Swain Chosen for Chandler Foundation Award

Friends of Professor Chandler presented in 1910 to the trustees of Columbia University a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from this fund is used to provide a lecture by an eminent chemist and to provide a medal to be presented to the lecturer in further recognition of his achievements in science. Previous lecturers on this foundation were L. H. Baekeland, W. F. Hillebrand, W. R. Whitney, F. Gowland Hopkins and Edgar F. Smith.

The lecturer this winter will be Robert E. Swain, professor and head of the department of chemistry, Stanford University. Dr. Swain's subject will be "Atmospheric Pollution by Industrial Wastes." The lecture will be in Havemeyer Hall, Columbia University, on Jan. 9, 1923.

Rose Polytechnic Institute Plans Mining Engineering Course

Philip B. Woodworth, president of the Rose Polytechnic Institute, Terre Haute, is developing plans for a course in mining engineering at the institution. A portion of the new college buildings will be assigned for this branch of study, which will be placed on an equal footing with the five other departments of the school. The Bureau of Mines will co-operate with the new department and Prof. R. L. McCormick, now in charge of applied mechanics studies at the college and active in mining engineering for 30 years past, is considered as the probable head of the new course of instruction. No definite date has as yet been established for the inauguration of the department.

Electrochemists Hear of Burma

Rangoon, Mandalay and Other Familiar Places Made Lively by A. C. Matheson

A regular meeting of the American Electrochemical Society was held in Rumford Hall on Friday evening, Nov. 17. The principal speaker, A. C. Matheson, gave a delightfully informal talk on his trip around the world. His trip had for its primary purpose the inspection of a silver mine in Burma.

Shipping from Marseilles, he went through the Suez Canal, where he saw the tremendous army base for the British Mesopotamian army. One extremely interesting point in connection with this place was the piping of Nile water from a tributary underneath the canal to supply the base with drinking water. This supply was carried along with the army in a piping system as it advanced into Palestine. There were pictures, too, of the rugged Arab boats which can be found throughout the African coast and even out in the Indian Ocean.

Ceylon Tea and Perfumes

Everyone knows of Ceylon tea, but few have heard of the perfumes. These seem to be indigenous to the soil, or perhaps it should be said to the inhabitants. Each tribe has its own characteristic aroma. Here, too, the curious fishing catamarans were novel and the fish unusual but highly edible.

Early Chinese Metallurgy

Through the wonderful rice fields of Rangoon to the silver mine in the highlands back of Mandalay. Here the old silver mine worked by the Chinese as early as the fourteenth century and not abandoned until 1868, probably because of water in the mines, for they were down to the 300 ft. level. The old Chinese metallurgical furnaces and cupels are still intact.

Another interesting paper was presented by W. A. Davis, of the American Brass Co., on "The Analysis of Metals by Spectroscopy."

At the conclusion of the technical program, election of officers of the section took place. H. C. Cooper was elected chairman, James Kendall, of Columbia University, vice chairman; Paul DeV. Manning, New York City, secretary.

Extensive Program for Peat Production in Michigan

The Peat Products Corporation, Eaton Rapids, Mich., recently organized with a capital of $100,000, is making ready for intensive operations on a 440-acre peat bog, near the city. A complete mechanical plant is in course of completion and it is purposed to produce at the rate of 100 tons of dried peat per day, commencing early in December. John H. Collins has been appointed secretary-treasurer and general manager at the plant.

Training and Aiding Workers in Industry

Personnel Association Discusses Timely Questions Affecting Selection and Welfare of Employees

Development of organized effort to study the human factor in commerce and industry and to apply the principles and practices arising therefrom to the realities of American industrial life mark a 3-day national forum of personnel experts held in Pittsburgh Nov. 8, 9 and 10 under the auspices of the National Personnel Association. Many of the country's principal manufacturing and mercantile enterprises, public service corporations, universities, engineering societies and civic bodies were represented as active participants in the movement, sponsored and directed from the association's headquarters in New York City.

Co-operation With Colleges

Among the notable reports presented to the convention was one dealing with "Co-operation With Engineering Colleges," prepared by a committee of which W. E. Wickenden, American Telephone & Telegraph Co., New York, is chairman, and of which F. L. Bishop, dean of engineering, University of Pittsburgh, and G. H. Pfeif, secretary of the educational committee of the General Electric Co., are members. Outlining ways and means by which assistance, through the association, can be rendered by industries to engineering colleges, the report says:

"The engineering colleges have a strong claim on the assistance of the industries in return for services rendered. The schools have made inestimable contributions to scientific knowledge from which the industries have profited without cost. Education has increased earning power and so has made possible the markets on which many industries depend for existence. The colleges have expended on each engineering graduate from $800 to $2,000 above all fees received. The industries profit by this training and would be compelled to provide costly substitutes for it if it were not available."

Immigration

Immigration was a principal topic of the convention. Magnus W. Alexander, managing director of the National Industrial Conference Board, discussed "Our Immigration Policy and Its Social and Economic Effects." "The Immigrant's Point of View" was the subject of Michael I. Pupin, immigrant, inventor, consulting engineer and professor of electromechanics in Columbia University. W. W. Kincaid, Niagara Falls, N. Y., delivered an address on "Nationwide Co-operation in Personnel Work," and E. K. Hall, vice-president of the American Telephone & Telegraph Co., on "Management's Responsibility for and Opportunities in the Personnel Job."

A committee, headed by E. K. Strong, Jr., director of the Bureau of Educational Research, Carnegie Institute of Technology, submitted a report saying that "psychological tests and rating scales are used today by a considerable number of corporations, and it is very evident that their use is being extended within those companies and to still other companies."

Vocational Training

Discussing the development of men for executive positions, a committee, headed by C. R. Dooley, manager of personnel and training, Standard Oil Co. of New Jersey, said that "companies having had training courses for several years invariably report that the effort and expense involved are justified by the results."

H. M. Jefferson, manager of the personnel department, Federal Reserve Bank, New York, presented a report on industrial motion pictures, finding that many non-theatrical films are distributed and used and that the demand for them is increasing.

Numbering of Steel

A conference to consider the desirability of providing a system of designating qualities or kinds of steels by code numbers has been called by the American Engineering Standards Committee at the request of the U. S. Bureau of Standards. The conference will be held in Room 704, Department of Commerce Building, Nineteenth St. and Pennsylvania Ave., Washington, D. C., at 10 a.m., Dec. 6.

This conference will attempt to determine the desirability of applying a uniform numbering system to forging steels, casting steels, structural steels, including plates, tool steels or other steels not so classified.

While the American Engineering Standards Committee has invited to this conference representatives of all technical and industrial associations known to be interested in the subject, any organization which feels that it should be represented in the conference, but has received no formal invitation, is urged to communicate with the American Engineering Standards Committee, 29 West 39th St., New York City.

Germany Imports Chilean Nitrate

On account of the great demand from farmers and to maintain trade relations with Chile, the importation of 200,000 tons of Chilean saltpeter has been sanctioned by the German Food Ministry, the right to import being given only to the Verein der Saltpeter Importeure at Hamburg, according to the *Frankfurter Zeitung*. In return the verein must sell 50 per cent to German farmers and 50 per cent to the fertilizer trade.

It is said that the German Government was influenced to permit imports of Chilean saltpeter by the fact that the restrictions on its import previously existing were leading to demands in Chile that imports of German goods into that country be similarly restricted.

Government Officials to Form Association

Branches in All Important Cities to Bring About Better Co-operation in Federal Business

Under the direction of the Bureau of the Budget a definite effort is being made for the first time to increase the efficiency of our great federal business machine by bringing together, in the larger cities of the country, all officials of the government in whatsoever department they are engaged. The work is under the personal supervision of General Herbert M. Lord, director of the Bureau of the Budget, and Colonel H. C. Smither, his chief co-ordinator. According to the plan federal business associations are to be organized in the larger cities for the purpose of bringing about a closer co-operation and co-ordination in carrying out the government's business.

Expect Economies

In these associations it is expected that economies will be realized from the interchange of transportation facilities, the consolidation of purchases, the storage of supplies and the co-ordination of many other activities to the common advantage of each of the different departments concerned. It is expected that the association will make possible the elimination of much duplication and a reduction in the expense of operation of the government.

The first Federal Business Association was formed in Chicago. At the organization meeting it was found that few federal officials stationed in that city were acquainted with officials representing departments and bureaus other than their own. Other associations have been formed in Detroit, Milwaukee and Boston and have already been in existence sufficiently long to prove their utility. It is now planned to carry the organization into Philadelphia, Baltimore and other large cities.

Before this plan was conceived there was little or no contact among federal officials stationed in the same city, but it is now apparent that economies and other advantages of the greatest importance will be brought about.

Rise of German Potash Price Charged to Production Cost

Inland potash prices in Germany increased 250 per cent between Oct. 1 and Nov. 15, according to cable advices reaching Washington. The increase is chargeable largely to increases in freight rates, in coal prices and in miners' wages. Despite the increase in prices, it is estimated that the Germans will sell more potash in 1922 than in any pre-war year, deprived as they are of the Alsatian mines.

The same cable states that the German chemical industries had a good month in October with the sole exception of the dye producers, who report further decreases in the demand.

Dickson Will Be Dye Expert of State Department

Move May Presage Organization of Government Distributing Agency for Reparation Dyes

Announcement that the State Department has temporarily employed F. S. Dickson as an expert on dyes has been made. It is believed that this move indicates plans of the government to undertake the distribution of the reparation dyes.

Mr. Dickson, who directed the dye license plan under the emergency tariff act, will give the department the benefit of his expert knowledge of the dye situation and will advise as to the best method for the handling of the German dyes. As Mr. Dickson had to pass upon the applications of importers for the entry of foreign dyes and had to consult the American manufacturers to learn whether or not these dyes were satisfactorily produced in this country, the State Department feels that he is well qualified for the position.

The Secretary of State has made known that a note from the Allies has been received, notifying the United States that they will not oppose the receipt of German reparation dyes without cost, to be applied against the costs of the army of occupation.

Agricultural Chemists Hold Sessions in Washington

Chemists and professional men generally must be particularly careful to guard against any influencing of their opinions by the fee which they are receiving or by the desires of their employer. Senator Ladd, of North Dakota, himself a chemist, sounded the foregoing warning in the course of an address before the thirty-eighth annual convention of the Association of Official Agricultural Chemists, which was held in Washington last week. Senator Ladd fears that there is an increasing tendency to yield to the temptation to bring forth the opinions desired by the employer. He made specific references to expert witnesses. It is unethical, he said, for a witness to bring out only such part of the facts as will help the side which is paying his fee. It is the belief that it undermines the reputation of the processions, as well as that of the individual, when it is known that the expert witness would be able to make a strong showing for either side that employed him.

Dr. Harvey W. Wiley told the association that despite all of the research and effort it must be admitted that there is no known cure for cancer. He regards the possibilities of radium as promising, but it may be difficult to confine its effects to diseased tissue.

Officers were elected as follows: A. J. Patten, Michigan Agricultural College, president; R. E. Doolittle, of the Chicago office of the Bureau of Chemistry, vice-president, and W. W. Skinner, assistant chief, Bureau of Chemistry, secretary and treasurer.

Attempt to Stop Long Working Hours for Government Employees

The 12-hour day and 7-day week in government service and what is to be done to stop it was one of the questions under consideration by the executive council of the National Federation of Federal Employees, in session last week in Washington. In countless instances throughout the country the 12-hour day and 7-day week prevail in government employ. Specific instances of this abuse are cited by Vice-President Lee R. Whitney of Milwaukee, Wis., as occurring in his part of the country among firemen in the government buildings and lock masters on the Fox River in Wisconsin. The lock masters, according to Mr. Whitney, are on duty really day and night and often as long as 16 hours.

Engineers in most of the federal buildings in Washington work 7 days a week and in the Custodian Service in Baltimore, according to Vice-President Charles L. Wiegand of that city, the employees are on duty 7 days a week without extra pay and with no compensatory time. Similar conditions prevail in the Custodian Service almost everywhere in the country. Immigration and customs officers on the Canadian border are likewise working the 12-hour day and 7-day week.

These matters will be taken up by the council with the various departments or with Congress, as the situation may require.

Liquid Carbon Dioxide Research Fellowship Established at Mellon Institute

The liquid carbonic division of the Compressed Gas Manufacturers' Association announces the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, for the purpose of classifying, studying and developing the uses for liquid carbon dioxide. The founding of this fellowship is in accord with the desire of the members of the association to cooperate with users and prospective users of liquid carbon dioxide, with the object of developing efficient means of applying the gas and of obtaining fundamental data bearing on its use in various industries.

In addition to conducting research work, the fellowship will be made a clearing house of information regarding various uses of liquid carbon dioxide, and data will be kept on file for the accommodation of prospective users of this product.

The present incumbent of the industrial fellowship is Charles L. Jones, who will be glad to correspond with anyone interested in the use of liquid carbon dioxide in industry.

Bayer Co. Complaint Dismissed

The Federal Trade Commission announces the dismissal of its comp'aint against the Bayer Co., Inc., of New York City, manufacturer and distributor of Aspirin tablets.

Power Show Promises to Be Interesting

Exhibits Planned Will Touch Every Phase of Power Development and Application

The great interest aroused forecasts a phenomenal success for the first National Exposition of Power and Mechanical Engineering, which will open Thursday, Dec. 7, at the Grand Central Palace and extend through Dec. 13, with the exception of the intervening Sunday. Practically all of the exhibition space has been leased and requests for approximately two hundred thousand tickets have been received by the management.

The exposition covers the field of power and mechanical engineering from the moment the coal is taken from the ground until the power is turned into work in the final machine. Not only will there be representatives of prime movers and steam-generating devices but also exhibits of manufacturers who have devoted their efforts to the solution of the troublesome problems involved in burning fuel and making and using power.

Educational Aspects

Engineering university students are to be made especially welcome at the exposition. Special facilities have been offered for organized college classes to visit the show in a body and rooms will be set aside for special lectures about any of the material that is displayed at the show. In this manner the students will be given an intimate contact with the practical application of the various types of engineering apparatus exhibited. The exhibitors are planning to have properly equipped representatives who may explain fully the technical reasons for any apparatus or detail.

Interesting Exhibits

Among the exhibits of special interest will be that of Gillis & Geoghegan, who will show four models of telescopic hoists with complete equipment for removing ashes. Two electric models will be in operation.

The Keasbey & Mattison Co. will operate a steam unit with sections covered by various forms of insulating material. By means of thermometer readings and charts the actual savings in B.t.u. will be clearly demonstrated and the results will be worked out in various ways to show the savings in tons of coal and dollars and cents by the use of the proper kind of insulation.

The display of the Lunkenheimer Co. will feature two motor-controlled valves equipped with the Deane system of control. One of the valves is a 12-in. cast steel Monel mounted gate valve which made such a notable showing at the Essex tests, in which by means of this control the flow of steam from the open valve was stopped. A remarkably complete line of cast steel Monel mounted valves for operating conditions of 350 lb. W.S.P. and 800 deg. F. total temperature will also be presented.

Caetani to Be Guest of Honor at Engineers' Banquet

A reception and banquet at which Prince Gelasio Caetani, the new Ambassador from Italy to the United States, will be the guest of honor, is being planned by the Federated American Engineering Societies. L. W. Wallace, executive secretary of organization, has written Ambassador Caetani telling him of the desire of the engineers in this country to pay him this mark of respect. No information has been received as yet at the Italian Embassy as to the time of the new Ambassador's arrival. It is believed, however, that he will be in this country by the first of the year, in which case Mr. Wallace hopes to arrange to have Prince Caetani as the guest of honor at the annual banquet of American Engineering Council. If that proves to be practicable, arrangements will be made so that all engineers who desire may attend.

Personal

Dr. JEROME ALEXANDER has established himself as a consulting chemist in the Chemists' Building, 50 East 41st St., New York City.

Dr. CLARENCE W. BALKE, of the Pfansteel Products Co., of North Chicago, Ill., is to be chairman of a symposium on "Rare Metals in Industry" to be presented at the New Haven meeting of the American Chemical Society.

W. M. CORSE presented, to the Chemical Society of Washington, an address illustrated by motion pictures, entitled "The Mining and Smelting of Nickel Ores," on Nov. 9.

PAUL CROLL, formerly research chemist of the N. J. Zinc Co., has been engaged by the Patton-Pitcairn division of the Pittsburgh Plate Glass Co., Milwaukee, Wis.

WILLIAM P. CUTTER has resigned from the position of librarian of the research library of the National Aniline & Chemical Co. at Buffalo, to accept a position with Arthur D. Little, Inc., of Cambridge, Mass.

D. D. DROBYNS has been elected president of the Pennsylvania Oil & Fuel Co., Pittsburgh, Pa.

PETER FEIBERGER, a chemist who specializes in color work, has been appointed head of the dye investigation laboratory of the Customs Division of the Treasury Department in New York, and will be in charge of the tests of comparability which are necessary under the new tariff act in the coal-tar products paragraphs. He will also assist in the standardization work under the same paragraphs. Mr. Feiberger for the last several years has been retired from active work. He will appoint three assistant chemists to help in the work in New York.

HARRY GLAIR has recently been appointed assistant superintendent of the Whiting plant of the Standard Oil Co. of Indiana. Previously he had charge of the paraffin department of that company.

R. T. GOODWIN has joined the research staff of the Standard Oil Co. of N. J., specializing on shale oil.

Dr. ELLWOOD HENDRICK, consulting editor of *Chem. & Met.*, spoke at the open forum of the Peoples' Institute at Cooper Union, on Sunday evening, the 12th inst. His subject was "A Vision of Science." On Nov. 22 he will address the Wilmington, Del., section of the American Chemical Society on "The Language of Chemistry" and on Dec. 14 he will speak before the Chemistry Club of Princeton, N. J., on the same subject.

L. F. HOYT, chemical expert of the research department of the Larkin Co., Buffalo, N. Y., manufacturer of soaps, etc., gave an interesting address, Nov. 6, before the chemical group of the local Chamber of Commerce. He spoke, in part, on the importance of the chemical laboratory in modern plants.

SIDNEY HULL, at one time a research chemist in the organization of the Cincinnati Chemical Works, Inc., and later employed by the Newport Chemical Works, is now in the Chicago laboratory of the Western Electric Co.

CLIFTON N. JACOBS, formerly chemistry instructor at the Massachusetts Institute of Technology, is now chief chemist of the Diamond State Fibre Co., Bridgeport, Pa.

JOHN R. KEUBLER, editor of *The Hexagon* of Alpha Chi Sigma, the professional chemical fraternity, is in charge of the chemistry department at the Shortridge Technical School of Indianapolis.

Dr. OTTO KRESS has resigned his position as technical director for the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., to accept a similar position with the Thilmany Pulp & Power Co., Kaukauna, Wis.

L. G. KRUG, formerly with A. Daigger & Co., of Chicago, was recently appointed assistant sales manager for the Chicago Rawhide Co.

THOMAS LECLEAR, formerly with the Uniform Color & Chemical Co., of Perth Amboy, N. J., is now associated with H. B. Baldwin, chemist to the Newark Board of Health.

CURTIS C. MEIGS, formerly president of the consulting chemical engineering firm of Meigs, Bassett & Slaughter, Inc., with offices at 1304 Finance Bldg., Philadelphia, has sold his interest to Messrs. Bassett and Slaughter, who will continue to carry on the business at same address under the name of Bassett & Slaughter, Inc. Mr. Meigs has taken offices at 709-710 Stephen Girard Bldg., and has associated himself with Hugo Schlatter, formerly with the Hercules Powder Co., and W. B. Goentner, who was assistant chief mechanical engineer for the old firm. These men will carry on the work of consulting chemical engineering at this address.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, discussed radium in an address before the students of Smith College, on Nov. 10. On the following day he addressed the Connecticut Valley section of the American Chemical Society at Westfield. His remarks on that occasion were confined to helium.

Dr. C. R. MOULTON, director of the department of agricultural chemistry of the University of Missouri, has been appointed director of the bureau of nutrition of the Institute of the American Meat Packers' department of education and research, which position he has accepted, effective Jan. 1. Dr. Moulton was graduated from the University of Illinois in 1907. He received his master's degree from the University of Missouri in 1909 and took his doctor's degree at the same institution in 1911. From 1917 to 1918 he was an assistant in animal nutrition to the late H. P. Armsby at the Institution of Animal Nutrition, Pennsylvania State College.

Dr. W. H. RODEBUSH, professor of physical chemistry at the University of Illinois, addressed the Illinois section of the American Chemical Society on Nov. 21. His subject was "The Production of Helium for Military Purposes."

JOHN WALDO, who taught chemistry last year at Morningside College, is now an instructor in inorganic chemistry at Purdue University.

GEORGE B. WATERHOUSE has been appointed professor of metallurgy at the Massachusetts Institute of Technology, Cambridge, Mass.

W. R. WHITNEY, director of the research laboratory of the General Electric Co., Schenectady, N. Y., expected to sail for Europe on Nov. 21.

HENRY WIGGLESWORTH, formerly director of development of the General Chemical Co., has returned to the United States for a short season, after an absence of a year. Mr. Wigglesworth has made a number of valuable connections in chemical industry abroad, and will return shortly to Great Britain and the Continent on pressing business. He is stopping with his family for the present at Hotel Vanderbilt, New York.

W. W. WITMER, formerly a chemical engineer with the du Pont company and later connected with the Hoskins Process Development Co., of Chicago, has recently been appointed superintendent of the plant of the Special Chemicals Co., at Highland Park, Ill.

The Paint Manufacturers' Association of the United States has elected the following officers: President, Charles R. Cook of the Cook Paint & Varnish Co., Kansas City; first vice-president, Samuel R. Matlock, of Philadelphia; second vice-president, Samuel Rosenthal, of Chicago, and secretary-treasurer, George B. Heckel, of Philadelphia. The following directors were also elected: Dr. D. A. Kohr, of Dayton; L. T. Minehart, of Denver; H. J. Kuhn, of Houston; Andrew Butler, of Buffalo, and S. B. Woodbridge, of Philadelphia.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

Successful Business Promotion

National Paint, Oil and Varnish Association Well on Its Way Toward Doubling the Industry

A year ago when the general business depression was admittedly at its worst the national trade association of the paint and varnish industry outlined a most ambitious program of business promotion. Two campaign slogans were adopted: "Make 1922 the greatest paint and varnish year" and "Double the industry by 1926." Already there is abundant evidence that in spite of the unfavorable situation during the early months of the current year, the paint and varnish manufacturers will have attained the goal set for 1922. Furthermore, a great step has been taken toward the successful fulfillment of the 5-year program.

President Ernest T. Trigg, in his address last week before the annual convention of the National Paint, Oil and Varnish Association, predicted that 1922 will exceed the banner year of 1920 by 11.6 per cent. This is an increase of 31.6 per cent over last year's volume of production. Thus 1922 must be conceded "the greatest paint and varnish year" in the history of the industry. In one year the industry has attained almost a third of the 100 per cent increase set for 1926.

The "Save the Surface" and "Clean Up and Paint Up" campaigns have had a great deal to do with this remarkable showing, but back of these ideas is a story of intensive work, improved selling and advertising methods and constructive co-operation on the part of manufacturers and dealers.

More Thought to Fundamental Business Conditions

A study of the causes of business failures shows that the success or failure of individual enterprises depends largely on three sorts of factors: (1) Those within the particular plant or factory. (2) Those within the trade or industry. (3) Those involved in the general business situation. Or, as is stated by the Harvard Economic Service in one of its recent letters, "An enterprise may fail because its plant is antiquated or its technical methods are wasteful. Or it may fail because the trade in which it is engaged is decadent or temporarily overdone. Or it may fail because it is unable to survive the throes of widespread business."

Many of the industrial embarassments and bankruptcies of 1920 were largely due to the drastic monetary deflation, the general credit contraction and receding prices. Thus it was factors outside of their own organization and beyond their immediate control that were most responsible for their troubles. Out of this has come a realization of the value of a better understanding of general business conditions. The broader use of statistics and the more general study of the fundamentals of business are some of the progressive developments resulting from the lessons taught us by the business depression.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

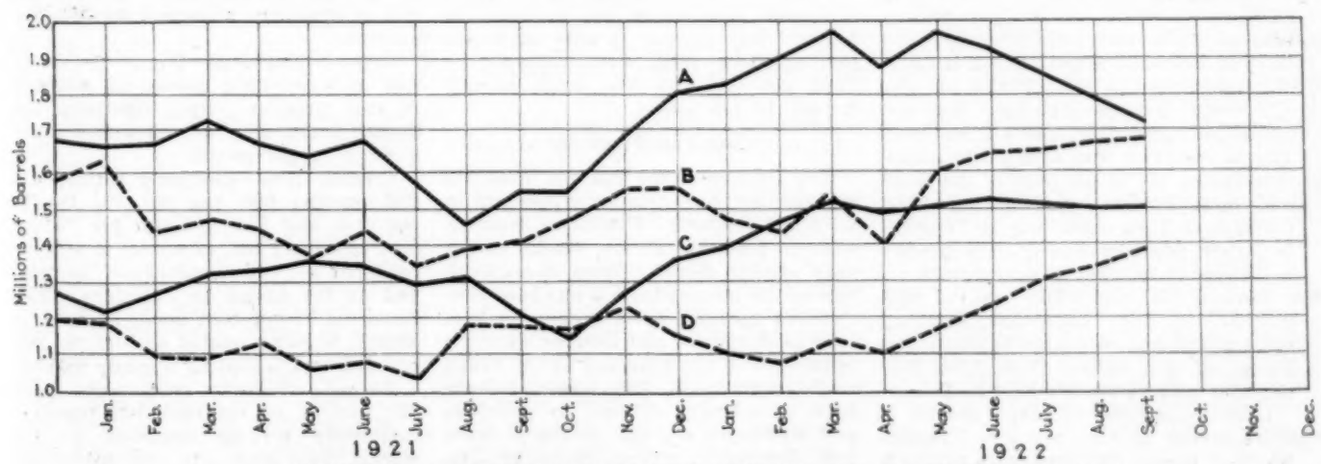
This week	162.83
Last week	158.70
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

The continued advance in this index shows an encouraging condition in the chemical market. Higher prices for methanol, formaldehyde, caustic potash and cottonseed oil more than offset the weaker market for ammonium sulphate, aniline and linseed oil.

Crude Petroleum Production for September, 1922

The outstanding trends in the statistics of crude petroleum for September, 1922, are that imports continued to decrease and consumption to increase. Since production was almost stationary, this resulted in the smallest net addition to stocks. 1,363,000 bbl., that has been recorded since October, 1921.

The daily average production, which has remained close to 1,500,000 bbl. for the last 7 months, amounted to 1,508,200 bbl. in September, according to the reports made to the U. S. Geological Survey. A gain of 24,616 bbl. in California was partially offset by losses in other states, including 7,711 bbl. in Texas and 6,868 bbl. in Oklahoma. The decrease in the imports of light crude oil from Mexico from 6,217,000 bbl. in July to 2,683,000 bbl. in September emphasizes the declining production in the Southern fields.



STATISTICS OF CRUDE PETROLEUM, JANUARY, 1921, TO SEPTEMBER, 1922
Daily Averages for —

(A) Domestic production of petroleum plus imports of "mineral crude oil."
(B) Consumption plus exports of domestic and imported petroleum.
(C) Domestic production (petroleum transported from producing properties).
(D) Consumption plus exports of domestic petroleum.

The New York Market

NEW YORK, Nov. 20, 1922.

Firmer prices throughout the list of chemicals were reported and the general demand for some of the basic chemicals was regarded as quite satisfactory. Prices are on a steady basis, with the tendency toward higher levels. Foreign competition has been less noticeable during the interval and spot stocks were greatly diminished among second-hand merchants. The feature of the week's activities appeared in the market for alcohol products. Manufacturers announced another advance on methanol and the entire list of solvents suddenly became the center of unusual activity. Arsenic still continued on its upward trend and was regarded as one of the strongest items of the list. Consumers have shown a desire to purchase at the high levels and spot supplies have become exceedingly limited. Domestic dealers in camphor announced an advance of 3c. per lb., bringing their price to 93c. per lb. The export market on caustic soda and soda ash revealed little change and transactions were mostly for small lots. Yellow prussiate of potash showed a very strong market and dealers advanced prices 1c. per lb. during the week. Bleaching powder, prussiate of soda, permanganate of potash, barium carbonate, bichromates and sodium compounds continued along moderate lines, with very little selling pressure noticeable.

GENERAL AND SPECIAL CHEMICALS

Acetate of Soda—Importers have been in direct competition with domestic makers and the market recorded a slight decline. Quotations were reported around 7¼c. per lb. for the imported and domestic grades.

Acetone—Carload quantities were held around 18½@19c. per lb. Most trading, however, was for small lots and sellers were asking 22@23c. per lb. Spot stocks are rather limited.

Alcohol—Makers of methanol have announced another advance of 10c. per gal. The 95 per cent material is being quoted at $1 per gal. in drums and $1.07 in barrels. The 97 per cent is held at $1.03 per gal. in drums and $1.10 in barrels. Ethyl alcohol is quotably unchanged at $4.75@$4.90 per gal.

Arsenic—Transactions have been recorded at 12¼@12½c. per lb. on spot. The inside price was difficult to ascertain during the latter part of the week and most holders were asking 12½c. Consumers have come into the market in larger numbers and dealers predict a 15c. per lb. market in near future.

Barium Chloride—The tone of this market has been somewhat unsteady and trading was restricted to small lots. Prices on spot ranged from $95@$105 per ton, with shipments held at $95.

Chlorate of Soda—The spot market is quite strong at 6¾c. per lb. Supplies are very scarce and producers report a well sold-up condition at the works.

Cyanide of Soda—The general condition is somewhat weak and sales were reported for small lots at 19½c. per lb. The domestic price is still holding at 25c. per lb., f.o.b. works.

Formaldehyde—The recent advance in methanol placed this product in a much stronger position. Dealers were not inclined to quote round lots and were asking as high as 14½c. per lb. for 10-bbl. lots. Factors reported a sold-up condition for the remainder of the year. The tendency is toward much higher levels.

Prussiate of Potash — Several transactions have been recorded up to 39c. per lb. Supplies remained very light and dealers showed little disposition to offer material at the market figure. The red variety was in good demand at 90c. per pound.

Prussiate of Soda—The spot market is easier and prices are fractionally lower. The demand is only moderate and small-lot sales were recorded at 21½c. per lb., with the range around 21¼@21½c. per pound.

COAL-TAR PRODUCTS

The feature of the coal-tar products market was the outstanding strength in all crude products. Producers report a sold-up condition at the works and a very strong demand from consumers. One of the largest factors has been consistently turning down orders for cresylic acid, phenol and benzene over the remainder of the year and as far ahead as February, 1923. Raw materials have been exceedingly difficult to purchase and deliveries on old contracts have been delayed in several instances. Imported material is being brought into the market very slowly and factors are not fearing any selling pressure, in view of the present tariff rates. Phenol continues quite scarce on spot and demand is exceedingly strong. Prices have been again advanced in the resale market, although makers have announced no new price.

Aniline Oil—Producers report the market fairly active, with business along moderate lines. The lowest price heard is around 16c. per lb. with the general range at 16@17c. per pound.

Beta Naphthol—The technical variety is moving in fair volume and the general tone is firm at 24@25c. per lb. Sublimed material is held at 55@60c. per pound.

Dimethylaniline—There has been a much stronger demand, due to the higher producing costs. The recent alcohol advance has added new interest and prices were advanced to 36@38c. per pound.

Ortho-Nitrophenol—Higher costs of raw material have caused an advance in this product. Spot offerings are limited and sellers have advanced prices to 85@90c. per pound.

Cresylic Acid—Domestic factors are still quoting 60c. per gal. for the 97 per cent and 55c. per gal. for 95 per cent material, but announce a sold-up condition for the remainder of the year and as far ahead as February, 1923. Imported 97 per cent goods on spot, in drums, is being quoted as high as 90c. per gal. and is finding a ready market.

Phenol—Producers continue to quote 22c. per lb. on contract, but report a completely sold-up condition at the works. Spot goods are very scarce and dealers are quoting up to 37c. per lb. for limited quantities. All indications point to a much higher market in the very near future.

Chemical Exports Continue to Gain

But Nine Months Total for 1922 Is Still Slightly Below Same Period of 1921

Although the exports of chemicals and allied products for the first nine months of 1922 still show a decrease over the corresponding period of 1921, the proportion of decrease continues to be lessened until the decrease is now only one-half of one per cent. The figures for 1922, according to a recent report of the Chemical Division of the Department of Commerce, are $79,741,439, and for 1921, $80,193,257.

The increases and decreases remain in about the same general classes—namely, fertilizers, explosives, and naval stores, gums and resins, for increases, and in coal-tar chemicals, and pigments, paints and varnishes for decreases.

Of the heavy chemicals exported, the largest increases are, as before, in caustic soda and borax, the per cent of increases being 330 and 210, respectively. However, some of the other sodium compounds did not fare as well, the exports of soda ash diminishing from $646,291 in 1921 to $502,518 in 1922, and of sal soda from $154,191 to $134,908. The following table shows some of the more important items.

Gains for the period under discussion over the corresponding period of 1921 occurred in the exports of explosives (55 per cent), perfumery and toilet waters (30 per cent), and fertilizers (7 per cent), exports of explosives increased from $1,515,205 (6,343,754 lb.) to $2,350,539 (12,979,433 lb.), and of perfumery and toilet waters from $3,515,070 to $4,551,619. Of the amounts of fertilizers exported for the 9 months of 1922, shipments of ammonium sulphate continued to increase from $4,119,858 in 1921 to $7,075,225 in 1922, and superphosphates from $94,030 to $317,087, while phosphate rock decreased from $5,803,811 to $4,442,948.

	Jan.-Sept., 1921		Jan.-Sept., 1922	
	Lb.		Lb.	
Acetate of lime	12,971,575	$283,711	22,884,395	$457,137
Calcium carbide	9,252,730	478,477	10,844,493	536,297
Bleaching powder	12,045,336	343,074	29,650,830	485,523
Copper sulphate	3,110,487	195,030	4,574,375	218,733
Glycerine	1,156,146	198,417	2,422,461	354,558
Bicrbonate of soda	8,371,534	225,819	11,853,935	256,332
Benzol	64,161,598	2,744,346	64,109,833	2,110,631
Colors, dyes and stains	.....	4,089,897	.....	2,736,177
Sulphuric acid	10,070,572	229,553	10,943,370	167,067
Formaldehyde	.....	275,901	.....	149,425

The St. Louis Market

ST. LOUIS, MO., Nov. 16, 1922.

Firmness is the important feature of the chemical market today, although very few price changes have taken place in the leading industrial chemicals since our last report. The volume of business transacted to date has been very satisfactory. Although a natural decrease in buying is expected at this period of the year for inventory purposes, it is not believed that this reduction will be above the normal this year, and it is expected that with the beginning of the year there will be a noticeable increase in business. Furthermore, it is not expected that the natural decrease this year will have any tendency to weaken prices, but that a steady tone will be maintained over the remainder of this year. Transportation facilities are still abnormal and not much improvement is expected for some time on account of the poor equipment with which the carriers are now operating.

THE ALKALI MARKET

As yet there is nothing startling or in fact nothing new to report in the alkali market. *Caustic soda* is moving only in a routine way and still maintains the prevailing price of the last 30 or 60 days. In 5-drum lots the solid is being quoted at $3.80 per 100 lb., and the flake at $4.25. *Soda ash* is slightly weaker. No price decline in general has been noted, though in one or two instances quotations have been made 5c. under prevailing schedule, which is as follows: in quantities of 5 bags or more for the 58 per cent light, $2.20 per 100 lb., while the usual differential of 20c. for barrels over bags prevails. *Bicarbonate of soda* has for some time maintained a steady price of $2.40, and while no large orders are passing, the price is holding firm. *Sal soda* is entering a slow season, but prices have not declined any since our last report and sales are light.

GENERAL AND SPECIAL CHEMICALS

Sales of *citric acid* are very small, and of a routine nature. The firmness in the *oxalic acid* market was broken about 10 days ago with the arrival of a large lot of imported material. Apparently, however, this has now been absorbed and the market has again assumed a firmer tone. Domestic producers now quote 17c. per lb. in barrels and 17½c. per lb. in kegs, f.o.b. St. Louis. Trading in *tartaric acid* is normal and no sales of consequence have been reported. *Aqua ammonia* 26 deg. has shown no unusual activity in the past few weeks and prices remain unchanged. The *white arsenic* market is still soaring, and the best that can be done today is 12½c. per lb. in carload lots, f.o.b. St. Louis. The supply is very scarce and spot stocks are practically out of the question, and it appears that this shortage is going to last for some time, as some of the large producers report that their entire output for next year has been taken up. Further advances might be seen shortly. *Cream of tartar* remains very dull, with the demand practically nil. *Glycerine* is moving in good volume and prices remain firm at 18½c. in drums. The market is entirely in the producers' hands. Only small lots of *phenol* are offered and the aggregate of spot stocks is very small, and some imported material is in evidence. *Bichromates of potash and soda* are in fairly good demand, and contracts for next year's requirements are being offered at slightly lower prices than the spot market.

VEGETABLE OILS AND NAVAL STORES

Castor oil is still holding at its previous level of 13½c. in drums and moving in good volume. *Turpentine* continues to hang around $1.70 per gal., being quoted today at $1.68, 4c. lower than when we last reported. However, it has been above as well as below that price during the interval. *Linseed oil* has scarcely changed during the last 2 weeks and continues around $1.

The Iron and Steel Market

PITTSBURGH, Nov. 17, 1922.

Steel production continues at fully as heavy a rate as in October, when ingots were being produced at 40,000,000 tons a year, representing an operation of the steel industry as a whole at slightly above 75 per cent of capacity.

Shipping of steel is as difficult as ever, but in general shipments total as much as production. There has been a further accumulation of sheets. Even in October the independent sheet mills that make monthly reports showed 20,000 tons more produced than shipped, although at the beginning of October there was 102,198 tons produced on order and awaiting shipment.

FINISHED STEEL MARKETS QUIET

The finished steel markets are all very quiet, and some lines are practically stagnant. The market turnover is easily the lightest of any time this year. The condition does not reflect any decrease in actual consumption, being rather the result of the heavy deliveries on old orders now being made.

Finished steel prices are steady at basis rates—i.e., the rates that have obtained lately on late deliveries. The rather heavy delivery premiums that were ruling a couple of months ago on bars, shapes, plates and sheets have disappeared, that being the principal change in the market. It is possible now to get quite early deliveries on new orders, except in nails and the smaller sizes of merchant steel pipe. In these, particularly in pipe, the mills fall quite short of meeting customers' desires. This exceptional condition is of course a reflection of the remarkable boom in garage and dwelling house construction.

Basis prices referred to above, which have lately been the regular prices of the Steel Corporation, are: Bars, shapes and plates, 2c.; merchant steel pipe, 66 per cent basing discount; hoops, ordinary specifications, including cooperage stock, 2.90c.; plain wire, 2.45c.; wire nails, $2.70; tin plate, $4.75; black sheets, 3.35c.

While black sheets have in the past week completed their decline to the Steel Corporation price, blue annealed sheets are frequently bringing above 2.50c. and galvanized above 4.35c., while automobile sheets seem to command 5c. in all cases, though the corporation's price, at which it has been sold out for some time past, is 4.70c. The corporation's prices on sheets for first quarter and tin plate for first half have appeared on the verge of being announced for 2 or 3 weeks past.

NO INDICATIONS OF PRICE CUTTING

From the viewpoint of last September, so large an increase in steel shipments as has occurred would probably have been expected to produce either price cutting or curtailment in operation at some mills through scarcity of orders, but there has been no such development as yet. Apparently there are few independent mills and perhaps no large independent mills needing additional business to carry their present operating rate through the year. There is of course the contingency of some customers instructing mills to curtail the rate of shipment.

Prospects are that the Steel Corporation will show a decrease in unfilled obligations for the present month, in view of the heavy shipments, the quiet market at present and the fact that the September increase of 741,502 tons and the October increase of 210,680 tons were due chiefly to heavy contracting for rails and track material, business that is now concluded. The unfilled obligations of 6,902,287 tons at the end of October is equivalent to nearly 6 months of production at a 75 per cent rate, the obligations being quite unequally divided, however, among the different products.

PIG IRON AND COKE

The pig iron markets in all districts continue stagnant and weak, with prices declining slightly at frequent intervals. Birmingham iron is down to $23, a drop of $2 in the week, and many of the Northern markets have declined $1. Valley basic has sold at $28 furnace, $1 under the nominal quotation of a week ago, but furnaces elsewhere are making prices that will force further declines if the valleys are to retain their trade. Valley foundry is down 50c. to $28.50, bessemer remaining at a nominal quotation of $32.

Connellsville furnace coke has lost 25c. this week, being now at $6.75@$7.25. The further decline brings little if any comfort to merchant furnaces, because these furnaces very largely covered to the end of the year on the decline of a month ago from $12 to $8, while the further decline in coke exerts an adverse sentimental effect on pig iron prices. Connellsville foundry coke remains at $8@$9.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	.....	$0.38 – $0.40
Acetone	lb.	$0.19 – $0.20	.20 – .22
Acid, acetic, 28 per cent	100 lb.	2.92 – 3.00	3.05 – 3.20
Acetic, 56 per cent	100 lb.	5.85 – 5.90	5.95 – 6.25
Acetic, glacial, 99½ per cent, carboys, 100 lb.	100 lb.	11.16 – 11.20	11.25 – 11.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	.....	.51 – .52
Hydrochloric, 18 deg.	100 lb.	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech	lb.	.11 – .11½	.11½ – .12
Lactic, 22 per cent tech	lb.	.06 – .06½	.06 – .07
Molybdic, c.p.	lb.	2.00 – 2.10	2.15 – 2.25
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg.	lb.	.05 – .05½	.06 – .06½
Nitric, 42 deg.	lb.	.06 – .06½	.06 – .07
Oxalic, crystals	lb.	.15 – .15½	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08½ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	.....	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	.....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	.....
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	.....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	.....	.....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	.....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	.....	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	.....	.30½ – .31
Tartaric acid, imported, powdered	lb.	.....	.31 – .32
Tartaric acid, domestic	lb.	.....	..... .32
Tungstic, per lb. of WO	lb.	.....	1.00 – 1.20
Alcohol, ethyl (Cologne spirit)	gal.	.....	4.75 – 4.95
Alcohol, methyl (see methanol)		.....	.....
Alcohol, denatured, 188 proof No. 1	gal.	.....	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	.....	.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash, lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08¾	.09 – .09½
Ammonium nitrate	lb.	.06 – .06¼	.06½ – .07¼
Amylacetate tech.	gal.	.....	2.35 – 2.60
Arsenic, white, powdered	lb.	.12½ – .12¾	.13 – .13½
Arsenic, red, powdered	lb.	.12 – .12¼	.13 – .13½
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 – 100.00	102.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate		.09 – .09½	.09½ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04¼	.....
Blanc fixe, pulp	ton	45.00 – 55.00	.....
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		.....	.....
Borax	lb.	.05½ – .05¾	.06 – .06¼
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.00 – 3.15	3.20 – 3.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05¼
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02¼
Calcium peroxide	lb.	.....	1.40 – 1.50
Calcium phosphate, tribasic	lb.	.....	.15 – .16
Camphor	lb.	.....	.90 – .92
Carbon bisulphide	lb.	.07 – .07¼	.07½ – .07¾
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	.....	.60 – .75
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	.....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	.....
Chalk, precip.—imported, light	lb.	.04½ – .05	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06½ – .06¾
Chloroform	lb.	.....	.35 – .38
Cobalt oxide	lb.	.....	2.10 – 2.40
Copperas	ton	27.00 – 28.00	29.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.	.....	.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.	.....	.25 – .26
Epsom salt (see magnesium sulphate)		.....	.....
Ether, U.S.P. 100 drums	lb.	.....	.14 – .15
Ethyl acetate com. 85%	gal.	.....	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.....	.90 – .95
Formaldehyde, 40 per cent	lb.	.14½ – .14¾	.14 – .15
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	.....
Fullers earth—imported powdered	net ton	30.00 – 32.00	.....
Fuse oil, ref.	gal.	.....	3.00 – 3.50
Fusel oil, crude	gal.	.....	2.00 – 2.25
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine, c.p. drums extra	lb.	.....	.18 – .18½
Iodine, resublimed	lb.	.....	4.40 – 4.50
Iron oxide, red	lb.	.....	.12 – .18
Lead acetate, white crystals	lb.	.....	.12 – .12½
Lead arsenate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	.....	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07¾
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	.....	1.00 – 1.80
Methanol, 95%	gal.	.....	1.00 – 1.07
Methanol, 97%	gal.	.....	$1.03 – $1.10
Nickel salt, double	lb.	.....	.11 – .11½
Nickel salt, single	lb.	.....	.12 – .12½
Phogene (see carbonyl chloride)		.....	.....
Phosphorus, red	lb.	.....	.40 – .45
Phosphorus, yellow	lb.	.....	.30 – .35½
Potassium bichromate	lb.	$0.10 – .10½	.10½ – .11
Potassium bromide, granular		.....	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.06 – .06¼	.06½ – .06¾
Potassium chlorate, powdered and crystals	lb.	.07½ – .08	.08½ – .09
Potassium cyanide	lb.	.....	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.	.....	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06¾	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16½ – .17
Potassium prussiate, red	lb.	.....	.90 – .95
Potassium prussiate, yellow	lb.	.39 – .39½	.39½ – .40
Rochelle salts (see sodium potas. tartrate)		.....	.....
Salammoniac, white, granular	lb.	.06½ – .06¾	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08¼	.08½ – .08¾
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 – 27.00	.....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07¾	.08 – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04¾	.04¾ – .05½
Sodium chlorate	lb.	.06½ – .07	.07½ – .07¾
Sodium chloride	long ton	12.00 – 13.00	.....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .10	.10½ – .10¾
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.60 – 3.65	3.70 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02¾	.03 – .03½
Sodium nitrite	lb.	.09 – .09½	.09½ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04¾
Sodium potassium tartrate (Rochelle salts)	lb.	.....	.18 – .21
Sodium prussiate, yellow	lb.	.21½ – .21¾	.21½ – .22
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03¾	.03½ – .04¼
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	.....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	.....	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	.....
Talc—domestic powdered	ton	18.00 – 25.00	.....
Tin bichloride	lb.	.10 – .10½	.10½ – .10¾
Tin oxide	lb.	.....	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07½ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX		.07½ – .08	.08½ – .08¾
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.80 — .95
Benzidine sulphate	lb	.82 — .85
Benzoic acid, U.S.P.	lb.	.77 — .75
Benzoate of soda, U.S.P.	lb.	.5 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthylamine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97–99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	.90 — .95
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25% car lots, in drums	gal.	.25 — .30
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½

Naphthalene, flake	lb.	$0.06½ —	$0.07
Naphthalene, balls	lb.	.07½ —	.08
Naphthionate of soda	lb.	.58 —	.65
Naphthionic acid, crude	lb.	.65 —	.70
Nitrobenzene	lb.	.10 —	.12
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.10 —	.12
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.55 —	1.60
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.35 —	.38
Phenol, U. S. P., drums	lb.	.37 —	.40
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.29 —	.31
Salicylic acid, U. S. P.	lb.	.35 —	.36
Solvent naphtha, water-white, in drums, 100 gal	gal.	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.20 —	.23
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.40 —	.42
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.22 —	$0.24
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.36 —	.40
Candellila, wax	lb.	.33 —	.34
Carnauba, No. 1	lb.	.39 —	.40
Carnauba No. 2, North Country	lb.	.24 —	.25
Carnauba, No. 3, North Country	lb.	.17 —	.18
Japan	lb.	.15 —	.15½
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02½
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05½
Stearic acid, single pressed	lb.	.09 —	.09½
Stearic acid, double pressed	lb.	.09½ —	.09½
Stearic acid, triple pressed	lb.	.10 —	.10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.60 —	....
Rosin E-I	280 lb.	6.65 —	....
Rosin K-N	280 lb.	6.75 —	$7.15
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	....
Spirits of turpentine	gal.	1.57 —	1.58
Wood turpentine, steam dist	gal.	1.35 —	....
Wood turpentine, dest. dist	gal.	1.25 —	....
Pine tar pitch, bbl	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	.....
Rosin oil, second run	gal.	.51 —	.....
Rosin oil, third run	gal.	.53 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hard wood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pine wood creosote, ref	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y	unit	4.60 —	....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.35 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	33.00 —	34.00
Potassium sulphate	unit	1.00 —	....

Crude Rubber

Para—Upriver fine	lb.	$0.24 —	.24½
Upriver coarse	lb.	.18 —	.18½
Upriver caucho ball	lb.	.18½ —	.18½
Plantation—First latex crepe	lb.	.24 —	.24½
Ribbed smoked sheets	lb.	.24 —	.24½
Brown crepe, thin, clean	lb.	.20 —	.20½
Amber crepe No. 1	lb.	.20 —	.20½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12½ —	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08½ —	.08½
Coconut oil, Cochin grade, in bbls	lb.	.08½ —	.09
Corn oil, crude, in bbls	lb.	.10½ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	....
Cottonseed oil, summer yellow	lb.	.11 —	.11½
Cottonseed oil, winter yellow	lb.	.12 —	.12½
Linseed oil, raw, car lots (domestic) bbls	gal.	.86 —	.87
Linseed oil, raw, tank cars (domestic)	gal.	.82 —	.83
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.86 —	.88
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.07½ —	.07½
Palm, Niger	lb.	.06½ —	.07
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10 —	.10½
Peanut oil, refined, in bbls	lb.	.13½ —	.13½
Rapeseed oil, refined in bbls	gal.	.77 —	.78
Rapeseed oil, blown, in bbls	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09 —	.09¼

Miscellaneous Materials

Shellac, orange fine	lb.	74 —	.75
Shellac, orange superfine	lb.	76 —	.77
Shellac, A. C. garnet	lb.	.75 —	.77
Shellac, T. N.	lb.	.72 —	.73

Other prices remain same as previous report.

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	net ton	50
Chrome cement, 40-50% Cr_2O_3	net ton	23–27
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b., Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	43–46
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	39–41
Magnesite brick, 9-in. straight (f.o.b. works)	net ton	75–80
Magnesite brick, 9-in. arches, wedges and keys	net ton	85–90
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	45–47
Silicon carbide refractory brick, 9-in	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	.10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	39.00 —	40.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	63.00 —	65.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.85 —	.90
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

Coke, foundry, f.o.b. ovens	net ton	8.00 —	9.00
Coke, furnace, f.o.b. ovens	net ton	6.75 —	7.00

Other Quotations Remain Same as Previous Report.

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent	20.00–21.00
Antimony, wholesale lots, Chinese and Japanese	6 60
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	30.00–31.00
Monel metal, shot and blocks	32.00
Monel metal ingots	35 00
Monel metal, sheet bars	38 00
Tin, 5-ton lots, Straits	37.125
Lead, New York, spot	7.05
Lead, E. St. Louis, spot	6 90
Zinc, spot, New York	7.275–7.325
Zinc, spot, E. St. Louis	6.95–7.00

OTHER METALS

Silver (commercial)	oz.	$0.64½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@55 00
Mercury	75 lb.	72.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

EL DORADO—The Lion Oil & Refining Co., 624 Finance Bldg., Kansas City, Mo., has arranged an appropriation of about $400,000 for the extensions and improvements in its local oil refinery, previously announced. A complete new plant unit will be constructed to increase the output to 8,000 bbl. per day. A 17-mile pipe line, with pumping plans, will also be built. Victor H. Smith is vice-president and general manager.

California

EMERYVILLE—The American Rubber Co. has awarded a contract to R. W. Littlefield, 351 12th St., Oakland, for the erection of a new 1-story plant at Emery and Park Sts., to cost about $25,000.

FRESNO—The Fresno Paper Co. has plans nearing completion for the erection of a new mill for the production of paper and paperboard, to be equipped for a capacity of 40 tons per day, estimated to cost in excess of $400,000, with machinery.

LOS ANGELES—The Pacific Coast Borax Co., Kohl Bldg., San Francisco, will take bids late in December for its proposed new 2-story refining plant in the Harbor District, Wilmington, 250x400 ft., estimated to cost close to $1,000,000, with machinery, power house, etc. Albert C. Martin, Higgins Bldg., Los Angeles, is architect.

Colorado

DENVER—The Colfax Pressed Brick Co., Clay St., has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Nov. 4, with loss approximating $30,000, including equipment.

Connecticut

STAMFORD—Richards & Co., Inc., a subsidiary of the Darco Corp., manufacturer of decolorizing carbons, guncotton products, etc., will commence the immediate erection of a new building at its plant, 26x30 ft., to be equipped for lacquer service and experimental work.

STAMFORD—The Charles H. Phillips Chemical Co. has construction in progress on a new 2-story operating and service building, with machine shop and power house.

ROCKY HILL — Supplementing a 1-story structure, placed in course of erection a few weeks ago, the Connecticut Foundry, Inc., has awarded another contract to C. P. Waterman, Inc., Hartford, Conn., for a new 2-story foundry, 30x70 ft.

Delaware

WILMINGTON—The Hammond Oil Products Co., recently organized, is planning for the erection of a new oil-manufacturing plant on site in the vicinity of the Brandywine River. Application has been made to the Board of Water Commissioners for water supply for the works.

Georgia

COLUMBUS—The W. C. Bradley Co. has acquired the local plant of the F. S. Royster Co., and will make improvements and extensions in the structure for the manufacture of fertilizer products. The factory will be used to replace the plant of the purchaser destroyed by fire a number of months ago.

MACON—The Chamber of Commerce is considering plans for the establishment of a local plant for the manufacture of calcium arsenate and kindred products. A company will be formed to operate the factory.

Idaho

WALLACE—The Galena Mining Co., a subsidiary of the Callahan Zinc-Lead Co., operating in the Cœur d'Alene district, is considering tentative plans for the installation of additional milling machinery and other equipment at its plant.

Illinois

GRANITE CITY—The National Enameling & Stamping Co. has foundations in progress for its proposed new 1- and 2-story sheet steel mill, adjoining its present works, estimated to cost in excess of $1,000,000, including machinery. The United Engineering & Foundry Co., Farmers' Bank Bldg., Pittsburgh, Pa., is in charge of construction. George W. Niedringhous is president.

Indiana

WARSAW—The D. J. Dalton Co. is planning for the rebuilding of its local foundry, partly destroyed by fire, Oct. 31, with loss estimated in excess of $15,000, including buildings and equipment.

INDIANAPOLIS—The Pure Oil Co. has acquired the local distributing plant of the Tiona Refining Co., located on a 4-acre tract of property on Madison Ave., and plans for extensions and improvements. Headquarters of the purchasing company are in the Pure Oil Bldg., Columbus, O.

Kentucky

LOUISVILLE—The National Forge Co., 1572 Cherokee Road, will commence the immediate construction of a new 1-story foundry for the production of iron castings, 60x120 ft., estimated to cost close to $15,000, exclusive of main equipment, to be located on Garland Ave. Whitfield Clark is president.

Louisiana

SWARTZ—The Atlas Oil Co. plans for the rebuilding of its gasoline-refining plant, destroyed by fire, Oct. 31, with loss estimated at about $100,000, including machinery.

Maryland

BALTIMORE—The Johns Hopkins University, Homewood, has plans in progress for the erection of its proposed 2- and 3-story chemical laboratory, and will call for bids in the near future. Carrere & Hastings, 52 Vanderbilt Ave., New York, are architects.

BALTIMORE — The Union Chemical Co., formerly of Philadelphia, Pa., has acquired a building at 621 South Regester St., for a new plant. The present works will be removed to this location.

BALTIMORE—The Red "C" Oil Co., Keyser Bldg., is taking bids for the construction of a 1-story plant addition at the Key Highway and Lawrence St., 70x70 ft. W. W. Pagon, Lexington Bldg., is engineer.

Massachusetts

WHITINSVILLE—The Kupfer Brothers Co., 112 Wooster St., New York, N. Y., manufacturer of coated papers and other paper stock, has awarded a contract to the E. D. Ward Co., Worcester, for the erection of a large addition to its Riverdale mill, Whitinsville.

EAST LONGMEADOW — The New England Steel Casting Co., 100 School St., Springfield, will hold in temporary abeyance the rebuilding of its foundry at East Longmeadow, destroyed by fire several months ago. When the work is authorized, the proposed structure will be 1-story, 70x125 ft., estimated to cost approximately $50,000. Morris W. Maloney, 145 Chestnut St., Springfield, is architect.

CAMBRIDGE — The United States Tire & Rubber Co., 560 Commonwealth Ave., Boston, has commenced foundations for a new plant at 660 Charles River Rd., 84x135 ft., estimated to cost $100,000, including equipment. The structure will be occupied under lease. F. A. Norcross, 46 Cornhill St., Boston, is architect.

SPENCER—The Spencer Gas Co., 110 Main St., is considering the erection of an addition to its artificial gas plant on Elm St., to cost about $45,000. W. M. Russell, 77 Franklin St., Boston, is architect.

Michigan

DETROIT—The Charles B. Bohn Foundry Co., 3651 Hart St., manufacturer of brass, bronze and kindred metal castings, has plans in progress for a new plant addition.

MUSKEGON—The Central Paper Co. has completed plans for the erection of a new 3-story addition to its plant on Lake St., to cost about $22,000, exclusive of equipment. The company has disposed of a bond issue of $1,100,000, a portion of the proceeds to be used for expansion.

Minnesota

RED WING—The Red Wing Sewer Pipe Co., manufacturer of vitrified pipe, has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Nov. 1, with loss estimated at $150,000, with machinery.

Missouri

SPRINGFIELD—Immediately upon completion of its initial plant unit, 100x135 ft., on West Commercial St., now in course of erection, the Springfield Tanning Co., will commence the erection of a new 1-story and basement adjoining works, 60x100 ft. Headquarters of the company are at 214 Holland Bldg., Springfield. W. R. Wolfe is head.

New Jersey

CAMDEN—The Camden Pottery Co., manufacturer of sanitary earthenware, has awarded a contract to E. R. Hall, 34 South 17th St., Philadelphia, Pa., for the erection of a 2-story addition, 70x140 ft., estimated to cost approximately $30,000, to be located at Mt. Vernon and Mt. Ephraim Aves.

PLAINFIELD—The British-American Metals Co., 200 Broadway, New York, N. Y., manufacturer of metals and metal alloys, has awarded a contract to the Levering & Garrigues Co., 552 West 23rd St., for the erection of a 1-story addition, 40x150 ft., to its plant on South 2nd St., Plainfield, estimated to cost about $27,000. N. A. Staples is vice-president.

WAYNE—E. I. du Pont de Nemours & Co., Wilmington, Del., have discontinued operations at their local plant, used for the manufacture of naval powder, and will close the works permanently. The equipment will be removed to Beeling, Pa., where a similar plant is now being operated, the capacity of which will be increased.

TRENTON—The Enterprise Tire & Rubber Co., North Clinton Ave., has filed plans for the erection of a 1-story addition to its plant.

New York

COHOES—Fire, Nov. 4, damaged a portion of the plant of the Peerless Fibre Co., Ontario St., with loss approximating $10,000. It will be rebuilt.

North Carolina

CHARLOTTE — The American Machinery Equipment Co., Providence Rd., Myers Park, machinery dealer, is making inquiries for a quantity of chemical equipment for installation in a local plant.

Oklahoma

BARTLESVILLE — The Phillips Petroleum Co., operating gasoline refineries, has acquired two local gasoline absorption plants, heretofore operated by Waite Phillips. The new owner will take possession immediately, and plans for extensions and improvements in the plants.

TULSA—The local plants of the Pure Oil Co., the Tidal Oil Co. and the Roxana Oil & Gas Co. were partly destroyed as a result of a recent tornado, with aggregate loss estimated in excess of $600,000, including equipment. The mills will be rebuilt.

Pennsylvania

MARCUS HOOK — The Sun Co., Finance Bldg., Philadelphia, Pa., has plans under consideration for the erection of an addition to its oil refinery at Marcus Hook, in the vicinity of 7th and Green Sts., to increase the output by about 10 per cent. J. Howard Pew is president.

PHILADELPHIA—The Paper Manufacturers' Co., 826 Cherry St., has awarded a contract to the J. S. Rogers Co., Drexel Bldg., for the erection of a new 6-story plant at 5th and Willow Streets, 127x180 ft., estimated to cost close to $500,000, including equipment.

NEW CASTLE—The National Radiator Co. will commence the immediate erection of a 1-story foundry addition, 30x365 ft. A list of equipment for installation will be arranged at an early date. Headquarters of the company are at Johnstown, Pa.

NORRISTOWN—E. F. Woodhead, Swarthmore, Pa., has acquired the local plant of the Norristown Coal & Ice Co., vacated some time ago, and will remodel and improve the structure for a paper mill. Equipment will be installed at an early date.

NEWPORT—Fire, Nov. 8, destroyed a large portion of the plant of the Mineral Products Co., East Newport, manufacturer of prepared roofing specialties, with loss estimated at about $25,000, including equipment. John R. Morgan is head.

PHILADELPHIA—The Foreign Trade Bureau, Philadelphia Commercial Museum, 34th St., is in receipt of an inquiry from a company at Alexandria, Egypt, desiring to purchase equipment for a cottonseed oil mill, with capacity of 35 to 40 tons of cottonseed per 24 hours. Full information available upon request.

Rhode Island

PAWTUCKET — The Whatcheer Chemical Co., manufacturer of soaps, fertilizers, etc., has tentative plans under consideration for the rebuilding of its plant, destroyed by fire, Nov. 7, with loss estimated at close to $200,000, including machinery.

South Carolina

CLOVER—J. F. Pursley, Clover, is planning for the organization of a company to establish and operate a local mill for the manufacture of fertilizer products.

Texas

PASADENA — The Stauffer Chemical Co., Freeport, Tex., has acquired a tract of land near the Houston ship channel, Pasadena, totaling about 30 acres, as a site for a new plant for sulphur refining. Plans will be prepared at an early date.

TEXAS CITY—The Terminal Oil & Refining Co. is perfecting plans for its proposed local plant extensions, to include additional units at the topping works for the handling of 15,000 bbl. of crude oil daily, and the construction of 9 steel storage tanks. Considerable new machinery will be installed.

KENEDY—E. L. Patilo, Kenedy, is perfecting arrangements for the establishment of a local plant for the manufacture of soaps, washing powders, etc.

Virginia

STUART—S. A. Thompson, Stuart, is organizing a company for the development of mica properties in this section. A grinding mill and other equipment will be installed.

NORFOLK—Fire, No. 5, destroyed a large portion of the fertilizer manufacturing plant of the Fisheries Products Co., Money Point, Norfolk, with loss estimated at about $300,000, including machinery and stock. Preliminary plans for rebuilding are under consideration.

NEWPORT NEWS—A chemical laboratory will be installed in the new local high school to be erected by the School Trustees at 31st and Hungtington Ave., to be 3-story, 196x220 ft., estimated to cost approximately $600,000.

LEXINGTON — The Washington and Lee University has plans nearing completion for a new chemical laboratory building, estimated to cost about $110,000. Flournoy & Flournoy, Union Trust Bldg., are architects.

Washington

EDMONDS—The Union Oil Co., Seattle, has surveys in progress for the construction of a new oil-distributing and storage plant at Ten-Mile Point, near Edmonds, where a 120-acre tract of land has been obtained. estimated to cost about $500,000, with equipment. The new works will supplant the present Seattle station.

West Virginia

WHEELING—The Interstate Oxygen Co., 44th St., has awarded a contract to H. L. Searight, Wheeling, for the erection of a 1-story plant addition, 100x150 ft., estimated to cost in excess of $50,000, including equipment.

WEIRTON — The Weirton Steel Co. will commence the immediate construction of a new byproducts coke plant estimated to cost approximately $3,000,000. The Koppers Co., Union Arcade, Pittsburgh, Pa., is engineer and contractor.

PENNSBORO—John B. Yates, vice-president of the Premier Window Glass Co., with local plant, has acquired the factory of the Pioneer Window Glass Co., West View, Marietta, O. Possession will be taken immediately and improvements made. It is planned to resume operations at the plant early in the coming year.

Wyoming

RAWLINGS—The Producers' & Refiners' Corp., California Bldg., Denver, Colo., has selected a site at Greensville, near Rawlins, for its proposed new oil refinery, and has plans in progress for the initial unit. It will have a capacity of about 10,000 bbl. per day, and which will be increased to 25,000 bbl., with the erection of additional units at a later date. A pipeline will be constructed from the Ferris oil fields to the site. The company has also arranged for the construction of new storage and distributing plants at Ferris and Wertz.

Canada

ST. JOHN, N. B.—The Stephen Brick Co., Ltd., has tentative plans under consideration for the rebuilding of its plant at Little River, destroyed by fire, Nov. 5, with loss approximating $100,000, including equipment. The plant was practically new and only in service for a few months.

VANCOUVER, B. C.—The Powell River Co., Ltd., has preliminary plans under consideration for the erection of a large new unit at its paper mill, and addition to the power plant. The work is estimated to cost approximately $3,000,000.

VICTORIA, B. C.—The Seaman Paper Co., 208 South La Salle St., Chicago, Ill., in conjunction with the Bridge River Power Co., Victoria, and affiliated interests, is formulating plans for the construction of a new pulp and paper mill at Seton Lake, estimated to cost in excess of $750,000.

Industrial Developments

GLASS — The Scott-Warman Glass Co., East Stroudsburg, Pa., is completing the rebuilding of its plant destroyed by fire some time ago, and plans to place the works in service within the next fortnight. The company specializes in the manufacture of hollowware.

The Premier Window Glass Co., Pennsboro, W. Va., is perfecting plans for a resumption of operations at its plant about Jan. 1, giving employment to close to the maximum of 200 men.

Window glass plants in western Pennsylvania and eastern Ohio are granting a 10 per cent wage advance to operatives.

LEATHER—The William Amer Co., Philadelphia, Pa., is operating its tannery at full capacity, with incoming orders insuring continuance for some time to come.

Dungan, Hood & Co., Philadelphia, Pa., are running at approximately 75 per cent of normal at their local tanning plant.

The Castle Kid Co., Camden, N. J., is running full at its tannery, with heavy domestic and export orders for future delivery. Kid and cabrettas are the main items of production.

The Keystone Leather Co., Philadelphia, Pa., is advancing production at its plant.

Burk Brothers, Philadelphia, Pa., are operating on a basis of 65 to 75 per cent of normal at their tanneries.

C. J. Matthews & Co., Philadelphia, Pa., specializing in the production of glazed kid, are running in excess of 60 per cent of capacity at their tannery, and have orders on hand to insure this schedule for a number of months ahead.

METALS—The New Jersey Zinc Co., Palmerton, Pa., has placed two additional spelter furnaces in service at its local plant.

The International Nickel Co., New York, is advancing production at its new plant at Huntington, W. Va. Present sales are averaging about 1,500,000 lb. of nickel monthly and 400,000 lb. of Monel metal.

The Boston & Montana Corp., Butte, Mont., is arranging for the immediate resumption of operations at its local mill.

The Calumet & Hecla Co., Calumet, Mich., is advancing production at its smelting plant, which has been operating on a basis of about 80 per cent of capacity. Repairs have been completed to the furnaces at the electrolytic plant and increased output is being arranged.

The Ray Consolidated Mining Co., Ray, Ariz., is increasing shipments to its concentrating plant and a basis of approximately 2,500 tons a day has been established.

The Nevada Consolidated Copper Co., Ely, Nev., has placed two additional mills in service, making four mills now operating at the plant. It is planned to add two more mills by the close of the month.

The United Verde Extension, Jerome, Ariz., is developing a production of 3,000,000 lb. of copper per month at its plant, and expects to maintain this output for an indefinite period.

IRON AND STEEL—The Bethlehem Steel Co. is increasing production at its Steelton, Pa., works, and adding to the operating force. Practically all departments are now running on a full time schedule.

The Alan Wood Iron & Steel Co., Conshohocken, Pa., has postponed the blowing in of its No. 3 stack, recently announced, and will defer operations at the furnace until Jan. 1.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has placed its tie plate mill on a double turn, and expects to maintain this basis of operation for an indefinite period.

The Eastern Steel Co., Pottstown, Pa., relighted its furnace No. 1 on Nov. 9, following an inactivity of about 24 months. Repairs and improvements have been made to the unit during the curtailment. It is expected to maintain production for an indefinite time. The No. 2 furnace of the company at Swedeland, Pa., is still idle; it was shut down last July owing to coke shortage.

The Lavino Furnace Co., Philadelphia, Pa., affiliated with E. J. Lavino & Co., is arranging to change production at its Sheridan furnace from foundry iron to ferromanganese.

The Reading Iron Co., Reading, Pa., is maintaining full production at its different mills. The wages of puddlers have been advanced from $8 to $8.80 a ton. The increase affects about 600 men, engaged at the Reading, Columbia and Pottstown, Pa., mills.

The Claire Furnace Co., Youngstown, Pa., is arranging for the early resumption of operations at its blast furnace. This addition will make an active list of 31 furnaces out of a total of 47 in the Youngstown district.

The United States Steel Corp. has advanced production 5 to 7 per cent at its mills at Gary, Ind., during the past fortnight. The Illinois Steel Co., a division of the Gary mills, is running on a basis of 75 to 80 per cent of capacity.

MISCELLANEOUS—Paper mills at Monroe, Mich., are developing maximum capacities. Four plants devoted to boxboard production have adopted a night shift in addition to regular day operations, and are turning out about 1,000 tons of material per day.

The Procter & Gamble Co., Cleveland, O., manufacturer of soaps, powders, etc., is operating its four plants on a capacity basis, located at Cleveland; Port Ivory, Staten Island; Kansas City, Mo.; and Dallas, Tex. A wage advance has been made covering all plants, affecting about 10,000 workers. It will approximate $250,000 a year, gross.

The Trans-Continental Oil Co., Bristow, Okla., is completing its new local oil-refining plant, and will place the unit in service at an early date. It will have a capacity of 5,000 bbl. a day, and will increase the company's refinery production to 14,000 bbl. daily, maximum.

The National Fireproofing Co., Pittsburgh, Pa., manufacturer of hollow tile and other kindred burned clay products, is operating its plants at from 80 to 85 per cent of capacity, and has orders on hand and in prospect to maintain this basis of production for the next 12 months.

The H. C. Frick Co., Connellsville, Pa., has placed its Leith plant in operation after a shut-down for about 5 months past. All company plants in Fayette, Westmoreland and Greene Counties are now in service, and practically on a 100 per cent basis.

The Interstate and Foreign Trade Department, Chicago Association of Commerce, 10 South La Salle St., Chicago, Ill., reports an inquiry (No. 1605) from the Shanghai, China, branch of an American company, for a first-class chemist and engineer for the local office at Shanghai.

Capital Increases, etc.

THE ACME RUBBER MFG. CO., Trenton, N. J., manufacturer of mechanical rubber products, has filed notice of increase in capital from $500,000 to $2,000,000.

THE EMPIRE REFINING CO. OF DELAWARE, Oklahoma City, Okla., has filed notice of increase in capital from $2,750,000 to $4,850,000.

THE UNION STARCH & REFINING CO., Edinburg, Ind., has arranged for an increase in capital from $340,000 to $2,000,000 for expansion. A plant has recently been acquired at Columbus, Ind., and operations will be transferred to that location.

THE CHICKASAW REFINING CO., 60 Broadway, New York, N. Y., manufacturer of petroleum products, a Delaware corporation, has filed notice of reduction in capital from $10,000,000 to $2,500,000.

THE GENERAL CHEMICAL CORP., Detroit, Mich., has filed notice of dissolution under state laws.

THE MILLER & WRIGHT PAPER CO., 65 Duane St., New York, N. Y., has filed notice of increase in capital from $50,000 to $400,000.

THE CAMAGUEY SUGAR CO., George H. Houston, president, 60 Broadway, New York, N. Y., operating sugar refining plants in Cuba, has disposed of a bond issue of $6,000,000, a portion of the proceeds to be used for general operations, financing, etc.

THE ATLAS STEEL CORP., Dunkirk, N. Y., has arranged for a stock issue of $6,500,000 preferred, and 100,000 shares of common stock, no par value, a portion of the proceeds to be used for plant operations, financing and expansion.

THE GREAT NORTHERN PAPER CO., Madison, Me., is arranging for an increase in capital from $8,300,000 to $25,000,000, a portion of the proceeds to be used for general operations and expansion.

E. I. DU PONT DE NEMOURS & CO., Wilmington, Del., manufacturers of powder chemicals, etc., are perfecting plans for an increase in capital from $80,000,000 to $100,000,000.

THE SOLAR REFINING CO., Lima, O., manufacturer of oil products, will increase its capital from $2,000,000 to $4,000,000, for proposed expansion.

New Companies

THE NATIONAL CARBON COATED PAPER CO., Sturgis, Mich., has been incorporated with a capital of $650,000, to manufacture coated and other papers. The incorporators are James G. Van Horn, D. A. Hopping and C. L. Spence, 128 South Nottawa St., Sturgis. The last noted represents the company.

THE BUFFALO REFINING CO., Sherman, Tex., has been incorporated with a capital of $75,000, to manufacture refined oil products. The incorporators are F. M. Thompson, D. L. Cooke and B. F. Smith, all of Sherman.

THE REIS RUBBER PRODUCTS CO., care of J. I. Berman, 346 Broadway, New York, N. Y., representative, has been incorporated with a capital of $100,000, to manufacture rubber specialties. The incorporators are A. L. Berman, E. Tumin and A. S. Wechsler.

THE PLYMOUTH ROCK PAINT CO., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. Charles C. Mann is president; and Charles J. Landen, 3 Monadnock St., Dorchester, Mass., treasurer and representative.

THE MIDWAY CITY GLASS CORP., Huntington, W. Va., has been incorporated with a capital of $50,000, to manufacture glass products. The incorporators are B. W. Walton, N. Christian and R. T. Morris, all of Huntington.

THE PALATKA CLAY PRODUCTS CO., Palatka, Fla., care of the United States Corporation Co., 65 Cedar St., New York, N. Y., representative, has been incorporated under Delaware laws with capital of $300,000, to manufacture burned clay products. The incorporators are Robert W. Lyle, Keasby, N. J.; Elliott Norton, New York; and Alexander H. Jackson, Rutherford, N. J.

THE ALLOYS FOUNDRY CO., Room 750, 407 South Dearborn St., Chicago, Ill., has been incorporated with a nominal capital of $6,000, to manufacture special castings and kindred metal products. The incorporators are Charles B. Carter, Samuel W. Booth, Jr., and Allen Erikson.

THE HATFIELD RUBBER WORKS, INC., Newark, N. J., has been incorporated with a capital of $250,000, to manufacture rubber tubing and other rubber products. The incorporators are Andrew L. Hatfield, Abraham and Louis Beller, 92 Academy St., Newark. The last noted represents the company.

THE MISSISSIPPI VALLEY PETROLEUM CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $125,000, to manufacture petroleum products.

THE SIMPSON-COHEN-BOESCH CO., Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are H. I. Cohen, George Boesch and George L. Simpson, 391 Albany Ave., Hartford. The last noted represents the company.

THE COMMERCIAL IRON WORKS, INC., Portland, Ore., has been incorporated with a capital of $100,000, to operate a foundry for the production of iron, steel and other metal castings. The principal incorporator is William T. Casey. The company is represented by John M. Joyce, 606 Concord Bldg., Portland.

HOLTAGE & REMINGTON, INC., Providence, R. I., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture refined metals. The incorporators are B. A. Remington, Wallace Holgate and Ernest C. Baker, 60 Harvard St., Providence.

THE GATTI PAPER STOCK CO., New York, N. Y., care of Smith & Bowman, 38 Park Row, New York, representative, has been incorporated with a capital of $200,000, to manufacture paper products. The incorporators are H. Cowan, W. Meighan and N. H. Bowman.

THE RAY RUBBER PRODUCTS CO., Irvington, Newark, N. J., has been incorporated with a capital of $10,000, to manufacture rubber goods. The incorporators are E. A. London, Thomas J. Ryan and Daniel R. Smith, 54 Woolsey St., Irvington. The last noted represents the company.

THE CALUMET BAKING POWDER CO., 4400 Filmore St., Chicago, Ill., has been incorporated with a capital of $8,500,000, to manufacture baking powder. The company is now operating a local plant. The incorporators are Frederic O. Mason, Warren Wright and Sidney S. Gorham.

THE COMMODORE OIL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of $3,000,000, to manufacture petroleum products.

PAPER PRODUCTS, INC., Mechanic Falls, Me., has been incorporated with a capital of $10,000, to manufacture paper specialties. Ralph T. Parker is president, and Lerol G. Limerick clerk and representative, both of Mechanic Falls.

THE SEMI-STEEL CASTING CO., St. Louis, Mo., has been incorporated with a capital of $15,000, to manufacture steel alloy and other metal castings. The incorporators are J. H. Connor and C. F. Storckman, both of St. Louis.

THE UNITED LABORATORIES, 36 Clinton St., Newark, N. J., has filed notice of organization to manufacture chemical specialties. The company is headed by Herman G. Fauer and William H. Robinson, 10 Ridgewood Ave., Newark.

THE WHITEHOUSE PRODUCTS CO., 564 West Randolph St., Chicago, Ill., has been incorporated with a capital of $5,100, to manufacture chemical specialties. The incorporators are E. F. Menkin and Leo B. Samuels.

THE BARBERS' HILL OIL CO., New York, N. Y., care of H. P. Freece, 35 Wall St., New York, representative, has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are R. Constantian and C. O. Dunaway.

THE REPUBLIC GLASS CO., Monroe, Mich., has been incorporated with a capital of $150,000, to manufacture glass products. A local plant has been completed and operations will be started at once. The incorporators are Manuel M. Llera, William N. Mathews and Thornton Dixon, Monroe.

L. DEL TURCO & BROTHERS, INC., Newark, N. J., care of Toby Furst, 164 Market St., Newark, representative, has been incorporated with a capital of $100,000, to manufacture ceramic tile and kindred products. The incorporators are Louis and Peter Del Turco.

THE RELIABLE CHEMICAL & EXTERMINATING CO., New York, N. Y., care of H. N. Herber, 23 West 31st St., New York, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and affiliated products. The incorporators are C. Zanisek and M. M. Marcus.

THE WESTERN KENTUCKY REFINERY, INC., Warren, Ky., has been incorporated with a capital of $10,000, to manufacture petroleum products. The incorporators are J. Robert Kirby and Kirk Massey, both of Smiths Grove Ky.; and John B. Rhodes, Bowling Green, Ky.

THE SEMPLE MFG. CO., Trenton, N. J., has been incorporated with a capital of $100,000, to manufacture rubber specialties, tubing, etc. The incorporators are L. Bathews, George T. Nutt and Charles H. Semple, Brookville, Trenton. The last noted represents the company.

THE EASTERN ELECTROCHEMICAL CO., Brooklyn, N. Y., care of M. D. Bohrar, 154 Nassau St., New York, representative, has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are D. Goldklang, F. Paul and M. Loris.

THE KING LOUIS OIL CO., INC., Worcester, Mass., has been incorporated with a capital of $100,000, to manufacture oil products. Zephire Lagasse is president and M. R. Lagasse, 17 Dean St., treasurer. The last noted represents the company.

THE NORTHERN NEW JERSEY OIL CO., Montclair, N. J., has been incorporated with a capital of $50,000, to manufacture and deal in petroleum products. The incorporators are H. Russ Van Vleck, Arthur B. Marvin and Henry W. Trimble, 483 Bloomfield Ave., Montclair. The last noted represents the company.

THE INTERNATIONAL CHEMICAL CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $500,000, to manufacture chemicals and chemical byproducts.

THE AMERICAN MOULDED COMPOSITION CO., 1-5 Market Sq., Lynn, Mass., has filed notice of organization to manufacture composition insulation products. The company is headed by Thomas J. Cannon.

THE PEERLESS PAPER SPECIALTY CO., Brooklyn, N. Y., care of Myer Efros, 25 West 43rd St., New York, representative, has been incorporated with a capital of $30,000, to manufacture paper products. The incorporators are S. J. Rosenthal, B. Mossman and A. Robbins.

THE IMPERIAL OIL CO., Tampa, Fla., has been incorporated with a capital of $100,000, to manufacture oil products. W. F. Miller is president; A. Murray Allen, vice-president; and B. L. Hammer, secretary, all of Tampa.

THE MASON-GIBBS CORP., Buffalo, N. Y., care of Arthur J. Adler, Erie County Bank Bldg., Buffalo, representative, has been incorporated with a capital of $5,000, to manufacture chemicals and affiliated products. The incorporators are A. H. Mason and W. E. Gibbs.

THE JAMES A. MUIR CO., Whippany, N. J., has been incorporated with a capital of $100,000, to manufacture paper and paperboard products. The incorporators are E. R., Louis, and James A. Muir, Jefferson Station, Whippany. The last noted represents the company.

THE AMERICAN INTERNATIONAL OIL CORP., New York, N. Y., care of the Registrar & Transfer Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $3,000,000, to manufacture petroleum products.

THE H. R. KUHNHARDT, JR. CORP., New York, N. Y., care of Max Schenkman, 56 Pine St., New York, representative, has been incorporated with a capital of $400,000, to operate a metal refining plant. The incorporators are W. W. Wait, E. Armstrong and L. Debrigard.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9. Headquarters will be at the Hotel Jefferson.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20 — Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.